Chemical Week

[illegible] 7, 1956

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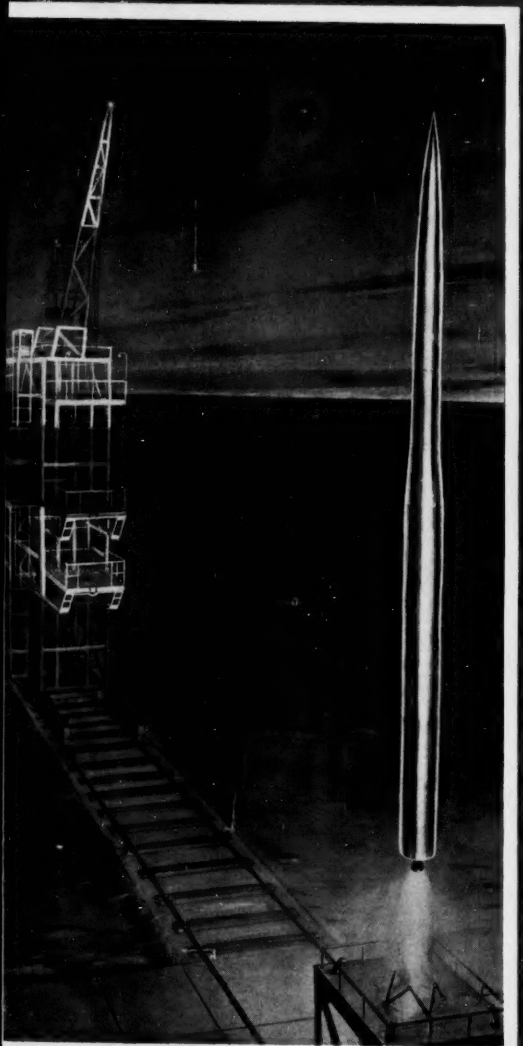

[illegible]'s no limit [illegible] chemical [illegible] in [illegible]llions-of-[illegible] year [illegible] field ... p. 31

[illegible] p. 18

[illegible] p. 27

[illegible] bids to [illegible] market for [illegible] p. 94

Is [illegible] lithium [illegible]capacity? [illegible] new and [illegible]ding uses [illegible] p. 122

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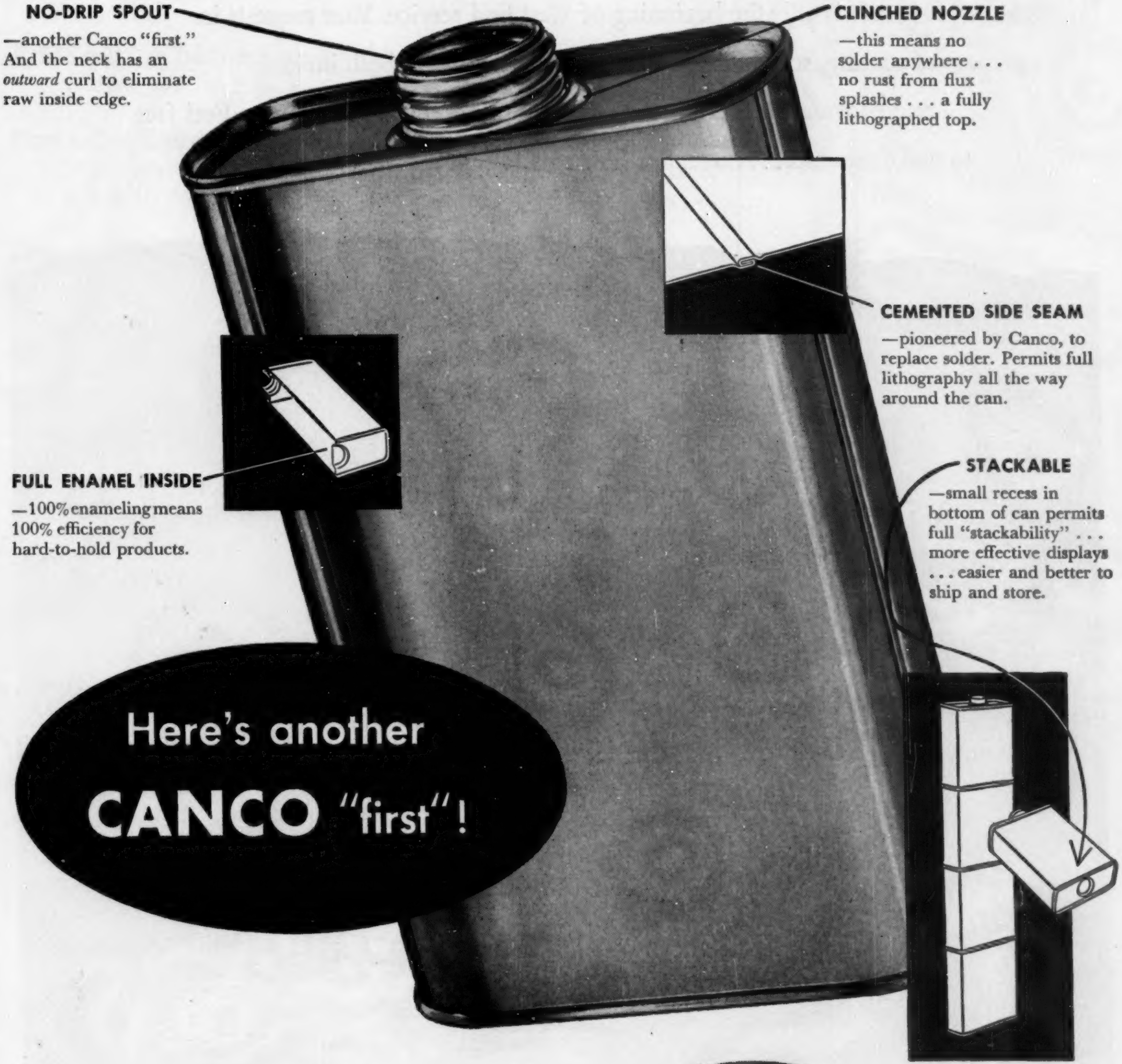

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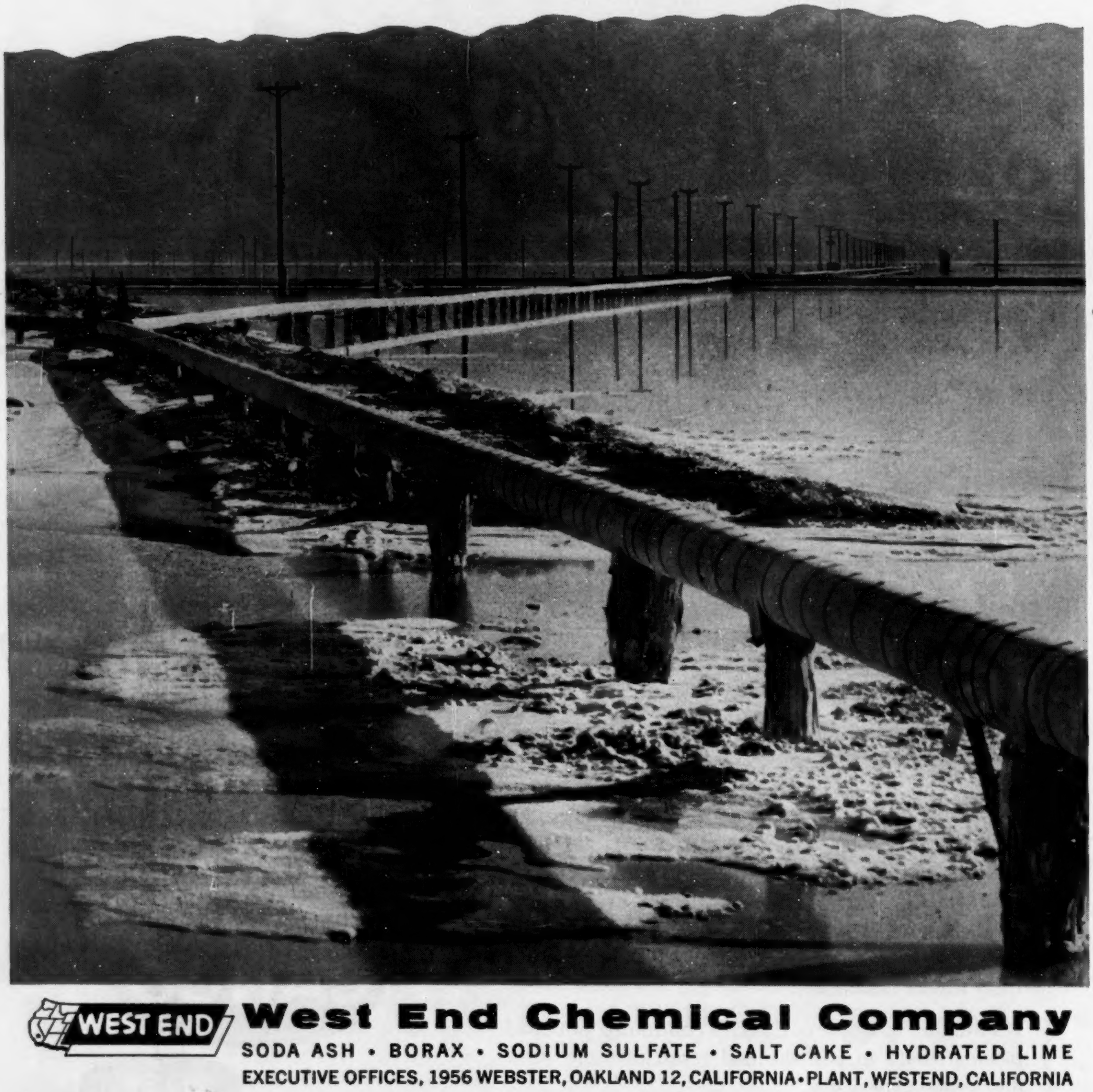

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Chemical Week

TOP OF THE WEEK — **April 7, 1956**

Chemical Week

April 7, 1956 *Vol. 78, No. 14*

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...AMONG SOME 3500 ORGANICS

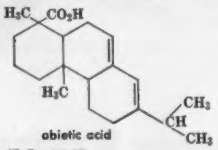
4323	4-Nitro-o-phenylenediamine MP 201-202° .... $NO_2C_6H_3(NH_2)_2$ ... MW 153.14	25 g. ..$2.50	100 g. ..$8.40

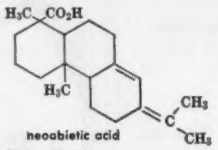
Far from the madding crowd's ignoble strife and to the eternal boredom of sophomores, a man named Thomas Gray published in 1751 some thoughts about Life inspired by the country churchyard of Stoke Poges in Buckinghamshire. From the same town, exactly 200 years later, two other individuals whose thoughts about Life were more along the line of what part α-keto acids might play in it, sent to the editor of *The Biochemical Journal* (*52*,38) a paper in which they introduced 1,2-diamino-4-nitrobenzene as a reagent for these acids, proclaiming it more specific than the previous favorite, 2,4-dinitrophenylhydrazine, because it forms stable nitroquinoxalinols which may be separated by paper chromatography.

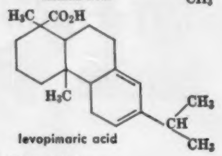
Actually this new reagent has been slumbering peacefully in our catalog for the past 16 years ever since we began making it as an intermediate toward a benzimidazole. A change of name in the interim toward the *Chemical Abstracts* form, *4-Nitro-o-phenylenediamine*, has made the grave a little harder to find. Now the **clarion call from Stoke Poges,** reinforced by an abstract we offer of a paper in *The Analyst* for August '55 on the use of the reagent in detecting and determining α-keto acids in blood and urine, brings life again to the old amine.

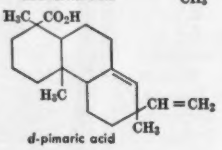
7151	Maleo-pimaric Acid .... $CH_2CH_2C_6H_7(CH_3)_2(COOH)CHCH_2CHC[CH(CH_3)_2]$:CHCCHCHCOOCO ... MW 400.52	100 g. ..$3.00	250 g. ..$6.75

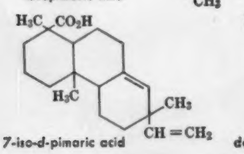
When the bark of a longleaf pine is scraped down into the sapwood, the wound exudes an item of commerce called gum oleoresin. This consists of a mixture of α- and β-pinenes, sold as gum turpentine, plus a mixture of the following resin acids:

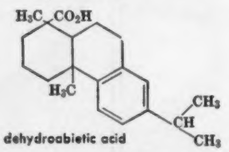

abietic acid


neoabietic acid


levopimaric acid

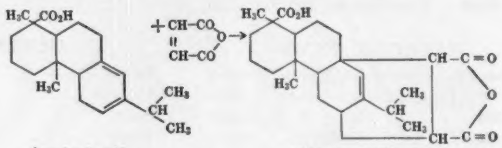

d-pimaric acid


7-iso-d-pimaric acid

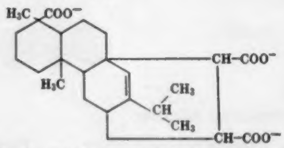

dehydroabietic acid

Dancing to the tune of temperature and pH, the loose protons and the double-bond electron configurations can twinkle around in these isomers like so many animated electric signs. If you do your work in the cold, you'll find that levopimaric acid is the largest single component of these resin acids; it is particularly dominant **in early spring sap.**

The levopimaric acid—and only the levopimaric acid—reacts exothermically with maleic anhydride, Diels-Alder-wise, to yield our new Eastman 7151:


levopimaric acid → maleo-pimaric acid

With the aid of a little sodium hydroxide, this can pick itself up a solvating charge at three places and go floating off to new adventures with all that molecular weight, water-soluble as you please.



Think, particularly, of the interesting esters it would make.

Prices quoted are subject to change without notice.

We're thankful for the pine trees exuding their sap, the scholars in Gray's back yard. We hope you'll be thankful that we stock some 3500 highly purified Eastman Organic Chemicals. *Distillation Products Industries,* Eastman Organic Chemicals Department, Rochester 3, N. Y.

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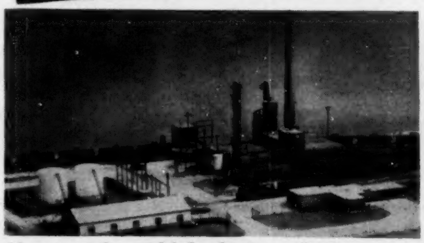

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Business
Newsletter

CHEMICAL WEEK
April 7, 1956

The on-again, off-again Reichhold-Catalin merger is on again. The boards of the two companies have okayed such a move, subject to Catalin stockholders' approval sometime in May. Reichhold owners have already approved. Reichhold will be merged into Catalin, with each Reichhold share worth 2.8 shares of the merged company—to be called Reichhold Catalin Industries—and each Catalin share worth one share of the new organization.

Reichhold's Henry H. Reichhold and Catalin President Harry Krehbiel, in an exclusive interview with *CW*, pointed out that a broad expansion is planned for the merged companies. They are negotiating with the Kuhn, Loeb investment house for new financing to strengthen the working capital situation.

For Catalin, the merger will give it access to raw materials and international outlets. For Reichhold, it fulfills a long-time desire, a public market for its stock. Catalin stock is listed on the American exchange, so public trading of the new stock would be almost automatic.

Also on the merger scene: United Dye & Chemical stockholders, at a special meeting, okayed a proposed merger with Handridge Oil, a privately held concern. Also approved: conversion of United's 7% preferred stock into common. The company hopes to retire United's outstanding 6% debentures after the merger becomes effective.

•

Public trading is ahead for Shulton, Inc., stock. Some 220,000 shares were sold this week, some by its original owners, the Schultz and Stanley families, some to raise new money. Gross proceeds: about $4 million. Shulton has more than doubled its total sales between 1951 and '55—but it's done even better, chemicalwise. Where it sold $200,000 worth of fine chemicals in '51, the '55 total was $2.5 million.

While Shulton is selling, Heyden hopes to buy. The company, which has some $13 million in cash assets on hand, says, in its just-issued annual report, that it "has investigated numerous potential acquisitions and is continuing most actively to seek attractive opportunities to expand the corporation's business through further acquisitions."

•

You can see more evidence of 1956 business health in these earnings reports—both for the three months ending Feb. 29:

Hooker Electrochemical, with an 8% sales rise—to $23.6 million—over the same period a year ago, showed a $2.8-million profit, up 21%. Both figures include results of Durez Plastics and Niagara Alkali, consolidated into Hooker last year.

American Marietta's sales of $37.6 million and net income of $2.3 million were up 31% and 62%, respectively.

•

Interhandel's efforts to get back General Aniline were applauded last week by the company's stockholders. At the holding company's annual meeting, some 83% of them voted to approve the management's effort.

But time is running out. Interhandel has just over 100 days to make such an effort in court. Unless it supplies the corporate records requested by U.S. government attorneys by July 24, its court case asking return of 97% of GAF's stock will be dismissed.

The government could then sell the stock to the highest bidder—as it did with Schering several years ago. (There's little chance that this Congress will upset the present law, which sets the rules for such a sale.)

Two court cases concerning antibiotics will not get to trial:

The tetracycline patent suits involving Chas. Pfizer, Bristol Laboratories, Upjohn and Olin Mathieson's Squibb Division have been settled by cross-licensing agreements. Agreement came as Bristol was issued its latest tetracycline patent (No. 2,739,924) covering production by aerobic fermentation in a medium containing bromide, iodide and thiocyanate ions.

Pfizer has licensed Bristol to make and sell the antibiotic under Pfizer's patent (No. 2,699,054). It has also licensed Upjohn and Squibb to sell the material. Pfizer and Bristol have exchanged options for cross-licensing of their various U.S. and foreign patents.

And the streptomycin suit filed by Mary Marcus against Selman Waksman, Merck & Co., and the Rutgers Research and Endowment Foundation has been thrown out of court because Miss Marcus repeatedly failed to appear for a pretrial deposition. The suit, in which $20 million worth of damages was asked, was dismissed "without prejudice" by Federal Judge Thomas Meany. This means that it could be filed again, though Judge Meany said that Miss Marcus would have to show strong reasons to get it reinstated.

•

Not to be dismissed lightly is a Treasury ruling on pension trust funds that—like Du Pont's—are invested in common stocks and debenture bonds. Under the rule, which interprets the 1954 Internal Revenue Code, such pension trusts have to pay a corporate income tax on dividends and interest. Exemptions would be granted only to organizations that invest in mortgages, preferred stocks and similar securities that are backed by a pledge of physical assets, not merely by a company's integrity.

Of course, most company pension plans are backed by an insurance company—and these wouldn't be affected by the ruling. But Du Pont and such other firms as Sears Roebuck, American Telephone & Telegraph, and the Bankers Trust Co. will. They'll all appear before Treasury officials April 11.

•

The week's expansion news:

M. W. Kellogg will build its polyethylene plant on a 93-acre site just east of Phillips Petroleum's Houston, Tex., industrial site (*CW Business Newsletter, March 10*). Phillips has already had one polyolefin plant taker for its own 950-acre tract—Celanese Corp. (*p. 22*).

Kaiser Aluminum & Chemical will expand by 27,500 tons/year its primary aluminum reduction capacity at Chalmette, La. It will add a ninth potline to the plant by summer of '57.

But Kaiser is opposing another expansion. A public utility group in Chelan County, Washington, has asked the Federal Power Commission for a license to build a hydroelectric power dam at Rocky Reach on the Columbia River about 10 miles upstream from Wenatchee, where Kaiser has an aluminum reduction plant. Kaiser and the Douglas County Public Utility District, which jointly plan a dam 40 miles upstream from Wenatchee, are opposing the Rocky Reach project because it would back water beyond their dam site.

Douglas and Kaiser have been jointly studying a 392,000-kw. power plant, with Kaiser financing the engineering work in return for a commitment to get 152,000 kw. of power.

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We suggest you check the items that are not in your library. Cut out the question box below, clip it to your letterhead, mail it to Ethyl Corporation, 100 Park Avenue, New York. We'll send you copies promptly.

Question	For the Answer	Check Here
How do you handle sodium?	"Handling 'Ethyl' Sodium"	☐
How small can it get?	"Using Sodium in Dispersed Form"	☐
What metals will the hydride descale?	"Sodium Hydride Descaling"	☐
What are the uses of sodium azide and how is it made?	"Chemistry and Uses"	☐
What alcoholates will it make?	"Sodium Alcoholates"	☐
How does it react with ammonia to produce the amide?	"Sodium Amide"	☐
How many alloys are possible?	"Sodium Alloys"	☐
What uses can be made of the hydride?	"Sodium Hydride"	☐
What fatty alcohols will it produce?	"Fatty Alcohols for Industry"	☐
How can alkyl sodium compounds be used?	"Alkyl Sodium Compounds"	☐
What new uses for sodium acetylides?	"Sodium Acetylides"	☐

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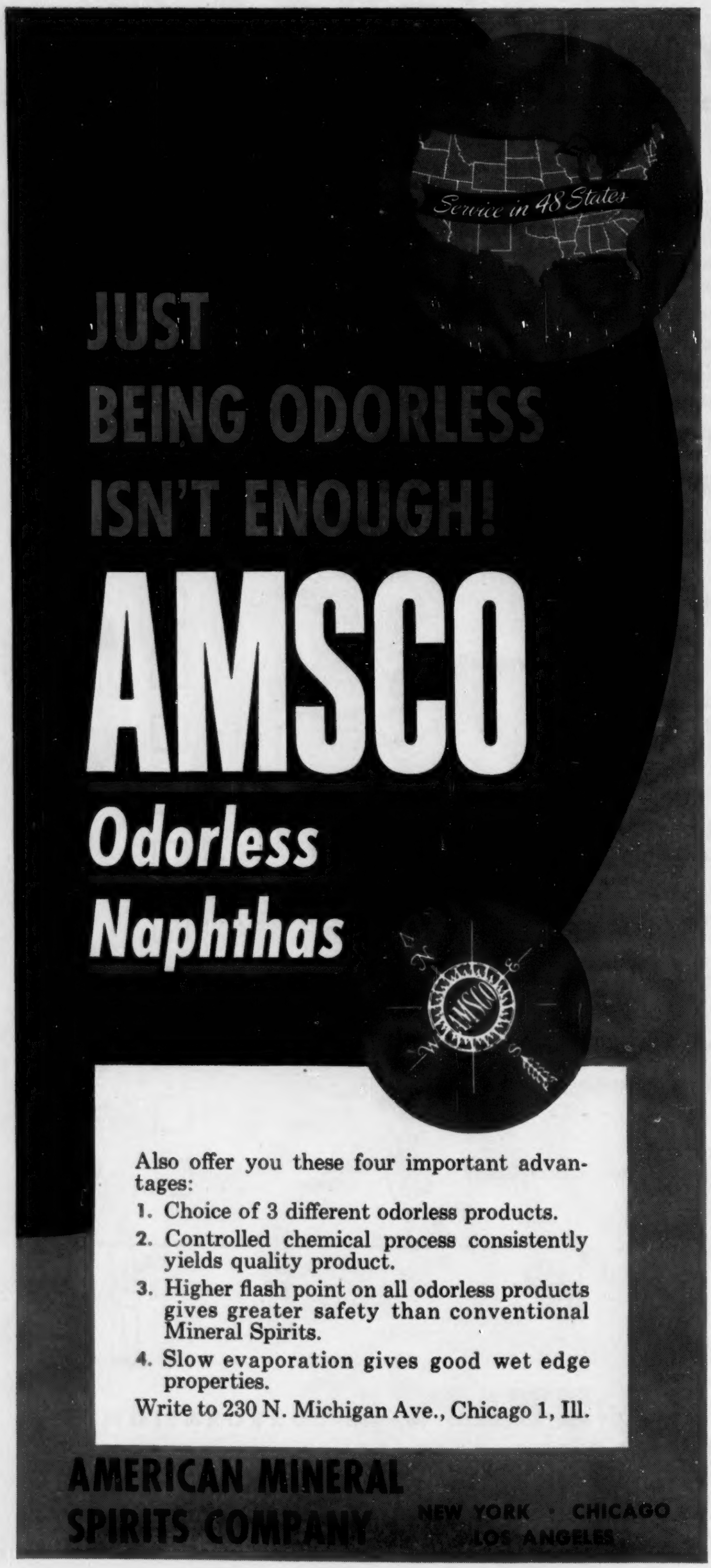

OPINION . . .

Emphasis on Fittings

DEAR MR. JOHNSON: [Re the story on gas cylinders] (*March 10*) . . .

I do have a little feeling that perhaps it would have been well to emphasize the use of the American Standards fittings, because the general use of these fittings would prevent such accidents unless, of course, homemade adapters get into the picture.

Incidentally, the new standards developed for medical gas cylinders have been quite effective in reducing hospital accidents. . . . Perhaps with a little round-table discussion, a solution of this whole thing can be worked out reasonably well.

ALLEN L. COBB
Safety Director
Kodak Park Works
Rochester, N.Y.

We did mention—although we didn't stress it—that the cylinder in question had been hooked up by means of an adapter.—ED.

Mutual Concessions

DEAR MR. JOHNSON: Your Jan. 21 issue (*p. 90*) contains an interesting and informative item concerning Becco's entry into the field of epoxidized olefins. This was an outgrowth of that company's research on ion-exchange epoxidation.

In describing this process, the story mentions the use of sulfonic acid cation-exchange resin, and then—in parentheses—"like Rohm & Haas' Amberlite IR-120 or Dow's 50X." We . . . would like to point out the omission of Chemical Process Co.'s Chempro C-20.

Not many people outside of the ion-exchange field are aware of the fact that there are very few firms in the United States engaged in the manufacture of a complete line of ion-exchange resins. Chemical Process Co.

CW welcomes expressions of opinion from readers. The only requirements: that they be pertinent, as brief as possible.

Address all correspondence to: H. C. E. Johnson, Chemical Week, 330 W. 42nd St., New York 36, N.Y.

holds a unique position in that it has pioneered and specialized in this branch of the chemical industry for nearly 20 years and has been notably successful in competing with larger, more diversified organizations.

Can you blame us then for feeling just slightly offended when our products are omitted when examples of ion-exchangers are given? . . .

I. M. ABRAMS
Associate Technical Director
Chemical Process Co.
Redwood City, Calif.

We concede that Dr. Abrams may justifiably feel slightly offended, but, on the other hand, he concedes that we were merely citing examples—not listing all appropriate products.—ED.

SEE YOU THERE

Scientific Apparatus Makers Assn. 38th annual meeting, Belleview-Biltmore, Belleair, Fla., April 8-12.

American Chemical Society, 129th national meeting, Dallas, April 8-13.

American Pharmaceutical Mfg. Assn., annual meeting, Boca Raton Club, Boca Raton, Fla., April 9-11.

Midwest Research Institute, symposium for management on applications of analog computers, Hotel Phillips, Kansas City, Mo., April 10-11.

Metal Powder Assn., 12th annual meeting, Hotel Cleveland, Cleveland, April 10-12.

Council for Agricultural & Chemurgic Research, annual conference, Congress Hotel, Chicago, April 10-12.

American Society of Biological Chemists, spring meeting, Atlantic City, April 16-20.

American Institute of Chemical Engineers and University of Pennsylvania, 4th annual meeting on "Experience in Industry," Museum Auditorium, Philadelphia, April 17.

National Industrial Research Conference, theme, "Research for Profit," Sherman Hotel, Chicago, April 18-19.

National Industrial Health Conference, meeting, Convention Hall, Philadelphia, April 21-27.

American Management Assn., conference on systems planning and control, Hotel Roosevelt, New York, April 23-24.

American Zinc Institute, 38th annual meeting, Hotel Statler, St. Louis, April 23-24.

American Oil Chemists' Society, Shamrock Hotel, Houston, April 23-25.

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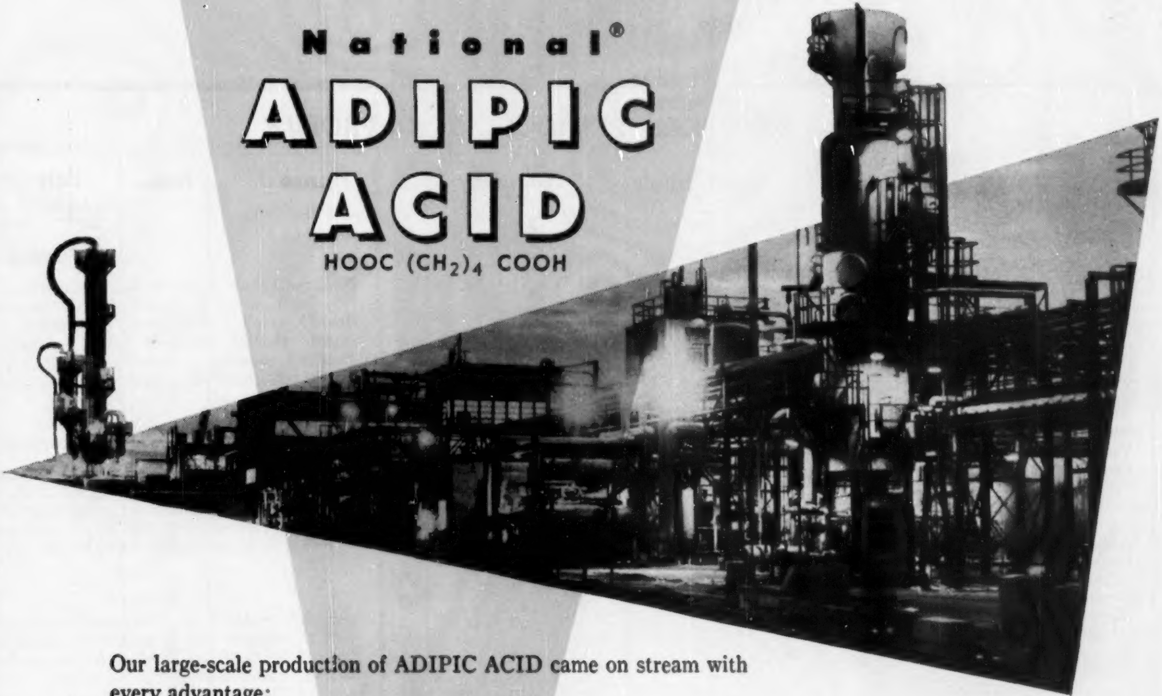

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This comprehensive 8-page technical bulletin on National Adipic Acid gives physical and chemical properties; principal reactions of the carboxyl and alpha methylene groups; solubility curve, and suggested uses with copious literature references.

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Chemical Week

April 7, 1956

EUROPEAN PETROCHEMICAL PROFILE

	Great Britain	Germany	France	Neth.	Italy	Be
Ammonia (& derivs.)	I S	F	OPA		M A	
Ethylene	IS B C	U			M	
Ethyl Alcohol	B	H				
Ethylene Oxide	I	H	N			C
Ethylene Glycol	IS	H	N			C
Ethanolamines			N			
Polyethylene	I U	R F O	H IGL		M	
Acetaldehyde	C				M	
Acetic Anhydride	C					
Acrylonitrile						C
Acetylene		H B			M S E	
Vinyl Acetate	C					
Vinyl Chloride		H		B		
Propylene	ISM B	F	F		M	
Propylene Tetramer	G					
iso-Propyl Alcohol	IS B	FE	SN	B	M	
iso-Propyl Acetate			N			
Acetone	IS	PF K	SN RH	B	M	C
Methyl Methacrylate	I	M				
Diacetone Alcohol				B		
Glycerine				B		
Butylenes	IS					
sec.-Butyl Alcohol	S	E		B		
Methyl Ethyl Ketone	S	K		B		
Butyraldehyde	B					
Methyl Isobutyl Ketone			S	B		
Butadiene	B	H			A	
Chlorinated Hydrocarbons	I	H F			M	
Benzene	S					
Ethyl Benzene		R				
Styrene	S F A	H B			M	
Alkyl Benzenes	SMR	E	T			
Toluene	S					
Xylene	S					
Naphthalene	S					
Phenol		P	RH			C
Sulfur	G			B		
Carbon Black	TP					
Ethylene Oxide Detergents	I	H				C
Alkyl Sulfate Detergents	S B		S	B		
Alkyl Aryl Sulfonate Detergents	SMR	E	E			
Glycol-Terephthalate Fibers	I					
GR-S Rubbers	D	H			A	
Butyl Rubber			C			
Epoxy Resins		D		B		

For Petrochemicals—New Life in a Six-

Last week's decision to let European coal prices go above their current ceilings will give chemical companies there a new incentive to turn to petrochemical production.

For U.S. companies, this will mean new markets for production know-how—and stiffer competition for products that are sold on the export market.

The rise expected in coal quotations, now that the European Coal and Steel Community has dropped its price ceilings, isn't expected to be over $1.50/ton. Though coal in Europe never was cheap, this boost may put even more life into the already-lively construction boom that has given five European countries extensive petrochemical industries. And a sixth country is planning its first chemicals-from-oil venture. (*Major units—present and planned—are shown in the chart above.*)

The progress has been remarkable. Generally such countries have been short of the capital needed for such investment. And for the most part,

y to Companies:

eat Britain

mperial Chemical Industries; S-Shell Chemical; Manchester Oil Refinery; R-Irano Products; British Petroleum Chemicals; F-Forth Chemis; G-Scottish Oils; U-Union Carbide Interional; C-British Celanese; C-Cabot Carbon; Philblack Ltd.; D-Dunlop Rubber; A-Grange emical.

est Germany

Chemische Werke Huels; R-Rheinische Olefin erke; B-Badische Anilin; P-Phenol Chemie; Farbwerke Hoechst; E-Rheinpreussen; K-Knapk-Griesheim; O-Kohle-Oel-Chemie; M-Rohm Haas; U-Ruhrbau; D-Deutsche Shell.

ance

Office National Industriel de l'Azote; P-Societe Phosphates Tunisiens et des Engrais et Proits Chimiques; A-Societe des Produits Azotes; Shell-St. Gobain; N-Naphtachemie; E-Esso ndard; P-Societe Atlantique-Progil-Electromie; H-Rhone-Poulenc; T-Petrosynthese; F-ancaise de Raffinage; C-Societe du Caoutchouc tyl; I-Pechiney; G-St. Gobain; L-L'Air Liquide.

etherlands

Bataafsche Petroleum Maatschappij.

ly

-Montecatini; S-Societa Sisas; E-Societa Edison; Azienda Nazionale Idrogenazione Combustibili.

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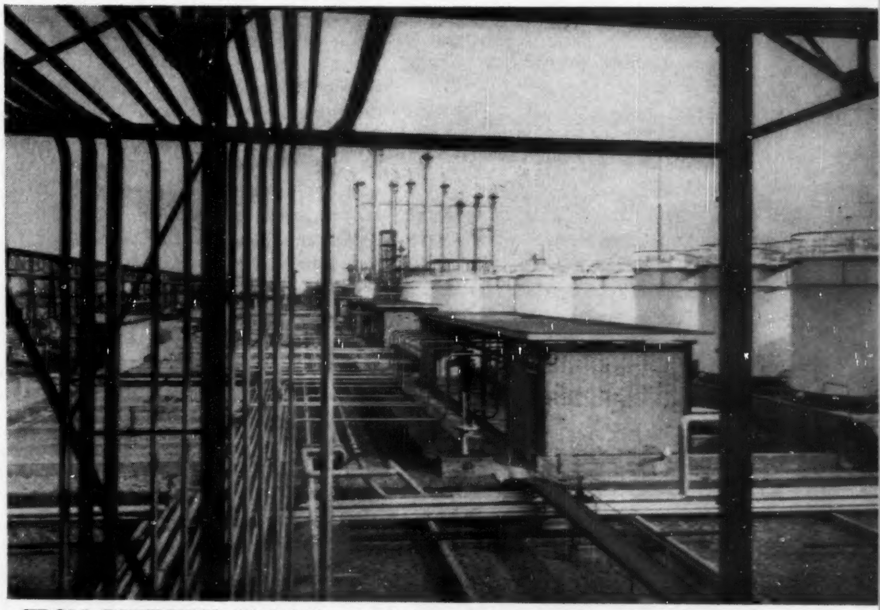
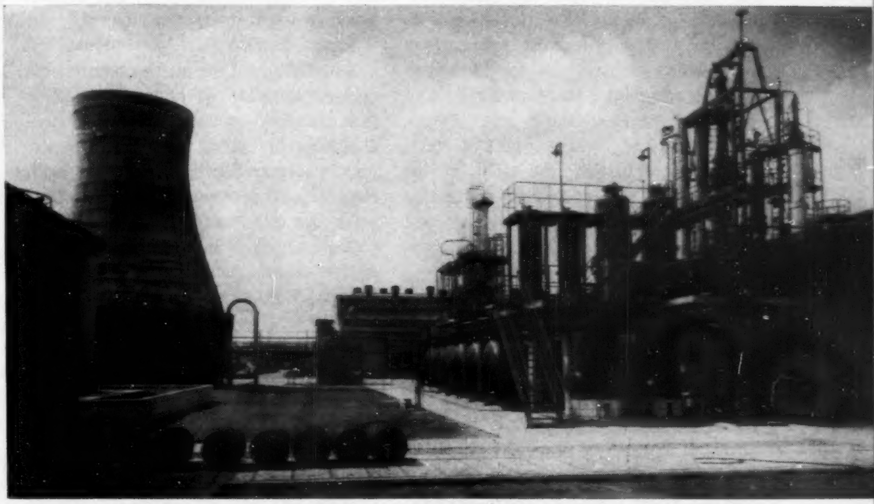


FROM REFINERY OLEFINS: Alcohols and ketones (above), detergents.



FROM COAL-GAS NO LONGER: Royal Dutch's polyvinyl chloride.

Year Boom

European technicians have not been familiar with the process and engineering know-how of petrochemistry.

Until now, there have been two factors pointing the way to petrochemicals. First is the fivefold expansion (since the war) of oil refining operations on the European continent. This was caused, mostly, by shortage of foreign currencies—making it easier to buy crude oil than oil products. Second was development—primarily in the U.S.—of vapor-phase cracking techniques that have made possible the production of olefins specifically for petrochemical use.

Last week's change in the coal price structure adds incentive to the list.

Expanding Market: But underlying the entire European petrochemical complex is the fact that the domestic market there has expanded to the point where plants are now economic.

During the late '30s, by contrast, when Shell's Dominguez, Calif., plant produced some 1,500 tons/month of solvents, the company studied the possibility of similar manufacture in Europe. Disadvantages: not only would the cracking capacity at a single site have limited production to 250 tons/month, but also the European market would not have been able to absorb such production. So it proved cheaper to import solvents from California.

This is no longer true. The chart shows that within a few years western Europe will have a chemical industry based on oil and gas with all the characteristics of its American counterpart. The picture, however, is not the same

in each nation. Here's how things shape up country by country:

Great Britain: Dominant factor here is, of course, Imperial Chemical Industries, which has concentrated activities at its Wilton and Billingham works. Vapor-phase cracking of some 250,000 tons of petroleum naphtha gives 40,000 tons/year of ethylene, 30,000 tons/year of propylene and butylene. By 1957, ethylene production will be boosted to 60,000 tons/year. All but 5,000 tons of the ethylene will go into polyethylene.

The Billingham ammonia works, now based on coke-derived water gas, is being converted to use crude oil—via the Texaco partial-oxidation process.

ICI plans construction of a 10,000 tons/year GR-S rubber plant, using its butylenes.

Shell Chemical is building a plant for 20,000 tons/year of alkyl benzenes near its Shellhaven (Essex) refinery. A 75,000-tons/year ammonia plant using refinery gas for hydrogen will be completed there in 1958. The company has also taken over Petrochemicals, Ltd., whose plant at Partington is reportedly the only one in Europe that produces such aromatics as benzene, toluene, xylene and naphthalene from petroleum for chemical use.

West Germany: The Huels works was one of the first to use natural gas for chemical purposes. It made acetylene, which was then used for butadiene. Though its plant was not damaged during the war, it was not allowed, following the armistice, to produce synthetic rubber, so it began making vinyl chloride, ethyl alcohol, oxide, glycols and other products instead. Huels is now the largest German producer of PVC, with a capacity of 16,000 tons/year, and of ethyl alcohol. Now again making rubber, it is erecting a 30,000-tons/year GR-S plant, and will produce 36,000 tons/year of butadiene from butane, using the Houdry dehydrogenation process.

Farbwerke Hoechst plans a 20,000-tons/year Ziegler polyethylene plant at Hoechst, and Kohle-Oel Chemie plans a similar plant at Gelsenkirchen. Ruhrbau (half owned by Bayer) plans an ethylene plant using crude oil topping residues, and Deutsche Shell is seriously considering the manufacture of epoxy resins.

France: Polyethylene highlights planned French expansions. Péchiney, St. Gobain and L'Aire Liquide have definite plans to make the plastic, and Rhone-Poulenc, Kuhlmann and Compagnie Francaise de Raffinage plan a unit for Gonfreville. In addition, 10 rubber, chemical and oil companies have combined as the Société du Caoutchouc Butyl (Socabu) to build a butyl rubber plant in the Basse-Seine.

Naphtachemie, a joint subsidiary of Péchiney, Kuhlmann and Anglo Iranian, will double its current 9,000-tons/year ethylene oxide capacity at Lavera.

Netherlands: The Royal Dutch Shell subsidiary, Bataafsche Petroleum Maatschappij, is switching its vinyl chloride unit, which was based on ethylene derived from coke oven-gas, over to refinery ethylene.

Scheduled to come onstream at the company's Pernis location this year is a secondary butyl alcohol and methyl ethyl ketone unit, while a glycerine-from-propylene unit will be completed in 1957.

Italy: As in France, the occurrence and exploitation of natural gas fields was the key to the country's petrochemical industry. Montecatini operates nitrogen fertilizer units at both Ferrara and Novara. It plans another ammonia plant at San Guiseppe de Cairo, which will use either natural gas or oil as a source of hydrogen. At Novara, it is constructing an acetylene-from-natural-gas unit. Also to be provided: facilities for conversion into acetaldehyde.

Azienda Nazionale Idrogenazione Combustibili (ANIC) plans, with a '58 due date, a plant to make 30,000 tons/year of rubber and 350,000 tons/year of nitrogen fertilizer.

Belgium: Expected on line this year is the country's first petrochemical venture, an ethylene oxide and glycol plant that will use ethylene from Antwerp oil refineries. The unit is being built by the Société Chimique des Derivés de Petrole, joint subsidiary of Société Belge de l'Azote, Société Carbochimique and Union Chimique Belge.

Eventually, it's planned to make synthetic detergents and acrylonitrile from the oxide; also under consideration: use of propylene to make phenol and acetone, via cumene.

And these plants are but the first. In Europe, the petrochemical industry could well adopt the motto, "always building, never built."

Who's on First

While the United States was the first country to develop a large-scale petrochemical industry, Carbide and Carbon Chemicals did not become the first commercial petrochemical producer when it began production at Charleston, W. Va., in 1925. Mononitrotoluene was made from petroleum in Europe in 1907.

Straight-run gasoline made by Royal Dutch's Borneo refinery contained up to 40% aromatics, but because fuel quality was then judged by the lowness of its specific gravity, this gasoline was unsalable. Royal Dutch removed them by bubble tray column fractionation. One fraction, which contained over 60% toluene, was then nitrated in a plant erected in 1907 at Reisholz, near Düsseldorf, Germany.

This was one of the fascinating pieces of information reported to *CW* editors by New York chemical consultant August Rooseboom, who provided the data for this article from his records, and from knowledge of the European industry gained during the past 22 years. Rooseboom's specialty: technical liaison between U.S. and European countries on industrial chemical developments.

Ahead—Five-Year Plans

"A rolling expansion program—one that will be revised and projected five years into the future each year." That's how Pennsalt President William Drake tags his company' broad-stroke plan for growth.

This week the already highly diversified chemical firm moved a step closer to its first five-year goal—a $55-million expansion—because the $15-million debenture issue offered publicly last week is already 100% subscribed.

The acceptance recorded by the Pennsalt Bonds was unusual in a week that saw falling prices on many different bond issues.

In fact, the condition of the bond market was such that Tide Water Associated Oil halved (to $50 million) the amount of debentures it planned to sell on the open market. This lower amount, however, like Pennsalt's $15 million, sold well on the retail market.

That $15 million plus $40 million of its own funds should free Pennsalt from any additional financing, at least through the first leg of its expansion journey—to 1960.

Turnabout: For Pennsalt, choosing the debt-financing route to expansion is a turnabout in the company's financial policy. Why does a firm committed to equity financing switch to debt financing, contrary to company tradition?

In answer, Pennsalt financial vice-president, Ned Beale, states that such a long-term public bond issue is the most logical way for it to solve its expansion financing problem. The equity of each stockholder, he points out, had already been diluted as much as Pennsalt management deemed advisable. (There were 750,000 shares in 1946, but an additional 450,000 have been sold since then.) So management decided not to issue more stock to finance its five-year plan.

On the other hand, Pennsalt had not resorted to any extensive debt financing prior to the recent bond issue. In fact, its debt/capitalization ratio had been a mere 6.9% compared with a 35.1% average for the chemical industry as a whole. (Du Pont, which has stuck wholly to equity financing, is not included in this average.)

Still Conservative: Even now, with its added $15-million debt load, Pennsalt's debt/capitalization ratio has moved up only to 25.1%, still substantially lower than the industry-wide figure.

Not to be overlooked in Pennsalt's financial reasoning: a public bond issue generates a certain amount of public interest in a company. And the 106-year-old Pennsalt now admits it could benefit from this.

"Most people outside the industry still regard Pennsalt as only a heavy inorganic chemical producer. And that interpretation of our company's operations is unrealistic," Drake observes.

The Four Hundred: Pennsalt today produces some 400-odd products serving the chemical, metal, pulp and paper, agricultural, rubber, petroleum, glass, defense, and specialty industries. No one of these industry groups accounts for more than about 14% of Pennsalt's sales (which hit a record $67.8 million last year).

What's more, the firm's products run the gamut from heavy inorganics like ammonia, chlorine, caustic soda to such organics as aerosol propellents and refrigerants—chlorofluorohydrocarbons, latest addition to the company's chemical line, to be made in a multimillion-dollar plant at Calvert City, Ky. (expected onstream later this year).

This expansion in propellents and refrigerants is for Pennsalt only a part of its first five-year plan. In addition, Pennsalt also lists in its five-year schedule:

- Installation of facilities at Wyandotte, Mich., for high-test calcium hypochlorite production. This unit is due the first quarter of next year.
- Expansion of fluorspar mining and milling operations in western Kentucky. Raw materials from these formerly held-in-reserve resources will supply its nearby Calvert City operations with needed fluorine raw materials.
- A new unit at Paulsboro, N.J., to produce granular fertilizer, actually brought onstream just a month ago.
- A potassium hydroxide plant at Calvert City, Ky., brought onstream early this year.
- Expansion of anhydrous ammonia facilities at Portland, Ore., due in production the end of this year, with chlorine expansion at Tacoma, Wash., on line about the middle of this year.
- A 12,000-acre evaporated salt project on Great Salt Lake, Utah. This new facility is being developed jointly with Hooker Electrochemical, won't be producing for two or three years.

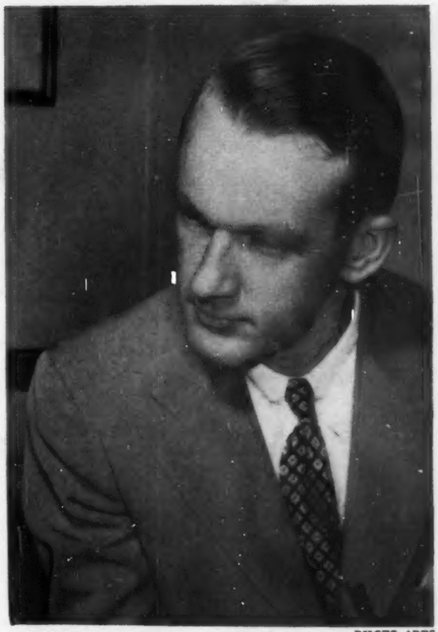


PHOTO ARTS

PENNSALT'S DRAKE: With a management committee, he steers a no-tangent course.

These Pennsalt expansions are a firm part of the first five-year plan. Other projects will be forthcoming according to a timetable prescribed by Pennsalt's management committee—a group of 12 key executives.

As far as future emphasis is concerned, that management committee will attempt to:

- Capitalize on Pennsalt's basic position (literally from the ground up) to upgrade fluorine and chlorine chemicals to inorganic and organic intermediates.
- Strengthen the firm's position in producing organic sulfur and ammonia compounds.
- Expand operations in the missiles field—because of Pennsalt's basic position in fluorine, chlorates, hydrogen peroxide, and related oxidizers.
- Enter the fluorinated plastics field.
- Further expand interest in the fields where it already has a strong foothold—especially pulp and paper, rubber, and specialty chemical industries.

'Witco has no intention of going public at this time.'

'We'll be doing more manufacturing. Polyesters are next.'

'Emulsol and Ultra are just beginning to be integrated.'

Private Ownership—Still the Key

In today's fast moving, highly competitive chemical arena, few privately owned chemical firms find it easy to survive as such.

Lately, in fact, many of their shrinking numbers have deemed it advisable (not to say unavoidable) to switch from private to public ownership via one route or another (Zinsser, Takamine, Stauffer, Reichhold International, Montrose, to mention a few).

Yet despite today's adverse economic pressures on privately held firms, one that will stay that way is Witco Chemical Co. Its management seems to have no more inclination to "go public" now than it did 36 years ago.

Witco's young president, Max Minnig—not of one of the founding Wishnick or Tumpeer families—put it this way to a *CW* editor last week:

"So far, our company has expanded successfully through its own capital resources—with some additional help from bank financing when we needed it. And we anticipate no financial problems in the immediate future that would change Witco's ownership status."

Where Now? Considering the fact that the company has been closely held for over three decades and subject to all the ups and downs that private ownership entails, what kind of force is Witco on the chemical scene today?

Certain recent moves on the company's part have led to much conjecture. Take the recent sale by Witco (*CW Business Newsletter, March 24*) of all its oil and gas producing properties for roughly $1.8 million.

"This move," Minnig says, "should not be misconstrued to mean we are weakening our position in carbon blacks. The oil and gas properties were not directly tied into our present operations."

Actually, gas from these wells will still supply part of Witco's requirements for natural gas raw material. Additional supplies have been negotiated to satisfy Witco's carbon black output.

How Much? That output today accounts for the largest chunk (but not more than half) of Witco's sales (estimated at roughly $30 million in 1955). Currently, too, Witco is improving its position in carbon black production by turning out more of the newer ISAF and HAF (intermediate super-, and high-abrasion furnace) blacks. These, Minnig says, are widely accepted today by manufacturers of abrasion resistant tires. Rubber uses currently take about 90% of all black production (the rest goes into ink, paint and plastics manufacture).

Besides continuing to bulkwark its carbon black production with part of its $1.8-million oil property sale net, Witco also intends to expand and diversify its present organic chemicals output.

Basic in Dibasics? New chemical ventures might well include in the near future: production of dibasic acids and polyesters for polyurethane foams. What's more, the firm has already started producing polyurethane "couplers," and will hike output of these.

But polyester production seems most imminent. One reason: Witco is already geared for polyesters at its two Emulsol Division plants in Chicago—plants that now turn out stearates, plasticizers and vinyl stabilizers, among other things.

Pilot-plant batches of polyurethane foams are already being "toyed with" in Emulsol's Chicago plant.

Short Term: Besides diversifying its chemical base, Witco's short-range plans include some ideas for its newly acquired interests—Emulsol—acquired a year ago and wholly owned—and Ultra Chemical Works (half owned).

"We are just beginning," Minnig says, "the final integration of these new associates into the existing Witco structure." Minnig envisions that both Emulsol and Ultra will diversify, marketwise, sell to outlets in rubber, paint and plastics industries rather than their traditional ones, such as the paper and agricultural fields.

Minnig feels that with Witco's years of experience in servicing paint and plastics producers, the parent firm could better handle Emulsol products going to these markets.

For that reason, Witco has taken on the sale of certain Emulsol products itself, allowed Emulsol to retain its own sales organization for agricultural, cosmetic and specialty chemicals.

Researchwise, Witco is due for some grooming. Minnig says it is very likely that in the near future Emulsol, Ultra and Witco research units will be combined into one coordinated research center serving all three companies. That move is still somewhat anticipatory, however, and, for now, each firm will continue to operate its own research facilities.

Long Look: While the domestic Witco picture seems rosy at the moment, overseas operations leave something to be desired. Minnig feels that

'Everyone likes to guess at Witco's sales and earnings.'

foreign operations have done "moderately well," so far. But the Witco home office (like many a chemical firm today) is running into trouble because of dollar exchanges—especially in Brazil, Argentina, and sterling areas (Australia and South Africa, particularly).

Minnig hopes that situation will clarify soon, as world trade conditions improve. When that time comes, Witco will consider the possibilities of manufacturing more of its products on a royalty or know-how exchange basis with chemical manufacturers overseas.

From now on, chemical industry can expect Witco to emerge more as a manufacturing chemical firm than as a sales entity (which it has been previously).

With six associated companies and 13 domestic plants, the firm is poised to move faster as a well-integrated producing entity despite its narrow—and private—ownership base.

New Twist on Trade

A trade agreement with a different twist—between Ross Products, Inc., of New York, and the West German Metzler Gummiwerke—may raise some interesting legal questions.

Metzler, one of the biggest German producers of rubber products, recently turned thumbs down on a large order of finished polyurethane foam novelties placed by Ross, a major chain store distributor with offices in New York. Reportedly, rumblings from certain U.S. concerns flashed a warning signal to Metzler, persuading them to stop shipment because of a possible patent infringement.

Now, after looking into the matter and gaining some reassurance from the U.S. Customs Bureau, Ross has signed a pact with Gummiwerke agreeing to pay for the material as it is produced—before shipment. And Ross has already received the first batches.

Of the three major U.S. urethane foam producers, Du Pont takes the firmest position. It reports:

"We believe our patents cover, broadly, all polyurethane foams sold in this country irrespective of whether they are produced here or imported. We have called our patents to the attention of most foam importers. Thus far, no proceedings have been instituted with the customs people to restrict imports, nor have any patent infringement suits been filed against importers of foam."

Ross feels Du Pont may have a difficult time proving a patent infringement in the case. But it's proceeding with caution, keeping a watch for any "protective measures" that may be in the offing.

Whose Jeopardy?

Industrial gas users who have been eyeing Arkansas as a possible plant site have a new factor to reckon with.

The state's Public Service Commission has, in effect, told the state's five natural gas distributing companies to increase industrial rates to at least 17½¢/1,000 cu.ft.

In virtually identical letters to the companies, the commission's general counsel told them, "We do not believe any utility in Arkansas can furnish gas to its industrial users for less than this amount without jeopardizing the interests of its other customers.

"We note, with some degree of apprehension, the high percentage of use by your industrial customers . . . the primary interest is to protect the price and future supply of gas for the benefit of the domestic and commercial users in this state. . . ."

Guiding the Missiles

Eger V. Murphree, president of Esso Research and Engineering Co., has been named by Defense Secy. Charles Wilson to be his special assistant in charge of the country's guided missiles program. Murphree will direct and coordinate research, development, engineering and production of guided missiles.

The appointment comes in the face of heavy Congressional criticism over the pace of U.S. ballistic missiles development, and claims tnat Russian missile programs may have outstripped the U.S. One main charge has been that there is no Pentagon official at a secretary or near-secretary level who puts in full-time on missiles work. Currently, each of the three military services has a hand in ballistic missile projects.

Murphree's authority is unclear. He apparently will be a coordinator, rather than a director of the missile programs now being run by the three services.

Murphree will be on leave from Esso, serving the Defense Dept. without compensation. He was picked, says Wilson, because of his technological background, administrative experience and ability to get along with people.

But Washington observers point out a further reason. Because of his experience working in a large organization, he shouldn't get frustrated in the Pentagon.

A plus factor, of course, is that Esso does not figure directly in missile development work as do many organizations from which Wilson could have gotten a manager.

With the rivalry between the military services so intense, Murphree's lack of preconceived ideas on the program will be a definite asset.

(*For an appraisal of the chemical industry's stake in missile development, see the CW report beginning on page 61.*)

WIDE WORLD

MURPHREE: He'll rev up the missiles program.

Washington Angles »

» **More money for basic research** will flow from the National Science Foundation starting this July. NSF, which operates now on a $16-million budget for research grants, training and teacher education, has asked for $41 million for the 12 months starting this July. The House, usually tight-fisted with basic research money, has okayed $36 million of the request, and NSF—facing Senate hearings next week—hopes more liberal senators will restore the $5 million lopped off by the House.

» **Someone apparently pushed the wrong button** — touching off a runaway chain reaction that quickly melted a reactor core at the Atomic Energy Commission's Arco, Idaho, reactor experiment station. AEC has no comment, but officials admit privately that Arco did have an accident.

Coincidentally, AEC—which wants chemical firms to get into the power reactor business—points to 1955's accident frequency record at its Oak Ridge installation, a new low of 2.07/million man-hours. AEC compares it with the chemical industry's 4.12 rate for 1954 and all-industry's 7.22.

» **Use of coal-tar Red No. 32 dye** for oranges is getting Congressional approval. After long deliberation, the Food & Drug Administration decided it would not oppose a law to take the color off its list of materials banned for food use.

The House Interstate Commerce Committee reported the bill out last week; passage is deemed to be almost certain.

» **Vote-conscious Republican senators** are out to ease the nation's farm surplus headache by encouraging the industrial use of agricultural products — alcohol blended with gasoline, for example.

Sen. Homer Capehart (R., Ind.) and 33 other GOP senators are backing a bill that would set up a $100-million/year agency to find and develop — through research — increased or new industrial uses for farm products.

Congressional observers are inclined to view these proposals as election-year moves to help offset farm unrest. They don't expect final enactment.

EXPANSION . . . .

Polyolefin Resin· This spring, Celanese Corp. of America will begin building a multimillion-dollar polyolefin resin plant near Houston, Tex. Capacity of the Phillips-licensed unit will be nearly 40 million lbs./year.

Completion is scheduled for sometime in the first quarter of 1957.

•

Newsprint: Great Lakes Paper plans to begin construction immediately of a $35-40-million, 100,000-tons/year newsprint unit slated for completion by July '58.

•

Magnesite: Construction will begin this month of Harbison-Walker Refractories, $1-million plant on Pere Marquette Lake (Ludington, Mich.) to produce refractory magnesite. Dow Chemical will supply brine-extracted magnesium hydrate for the process. Production at the plant is expected late this year.

COMPANIES. . . .

Carbide and Carbon Realty Division of Union Carbide plans to purchase a nine-acre tract in Houston, Tex. It will build a $300,000 office building and warehouse on the $450,000 site.

•

Basic Refractories stockholders have approved changing the company name to Basic, Inc. Also okayed: increasing authorized common stock from 650,000 to 1,250,000 shares. The increase will permit distribution of a 25% common stock dividend.

•

Both Warner-Lambert and Emerson Drug stockholders will now merge on the basis of one share of Emerson Class A and Class B common stock for one-half share of Warner-Lambert common. The merged firm will keep the Warner-Lambert Pharmaceutical company name.

•

National Lead this week takes over operation of AEC's uranium processing mill at Monticello, Utah.

FOREIGN. . . . . .

Polyethylene/New Zealand: Now under construction near Botany is Imperial Chemical Industries' (of Australia and New Zealand) $5-million plant to produce polyethylene. Full-scale operations should be under way by early 1958, with production slated for domestic markets.

•

Carbon Black/Brazil: A furnace-type carbon black plant with a minimum capacity of 30 million lbs./year will be built near Santos by Copebras, owned by Columbian Carbon, Celanese Corp., New York businessman Joseph Michaan and various Brazilian interests. Machinery, materials and equipment for the new plant will be imported from the U.S.

•

Ammonia/Japan: Toyo Koatsu Industries, in cooperation with Teikoku Oil Co., will establish a chemical plant in Biigata Prefecture, northwest Japan. The plant will produce ammonia, urea and other ammonia products. It will use natural gas as a hydrogen source.

•

Resins/Mexico: Bakelite de Mexico, a subsidiary of Union Carbide, has just started production of phenol-formaldehyde resins at a $160,000 plant in Monterrey. The new plant, which will continue to import its raw materials, has an annual capacity of 2 million lbs. All production is slated for Mexican markets.

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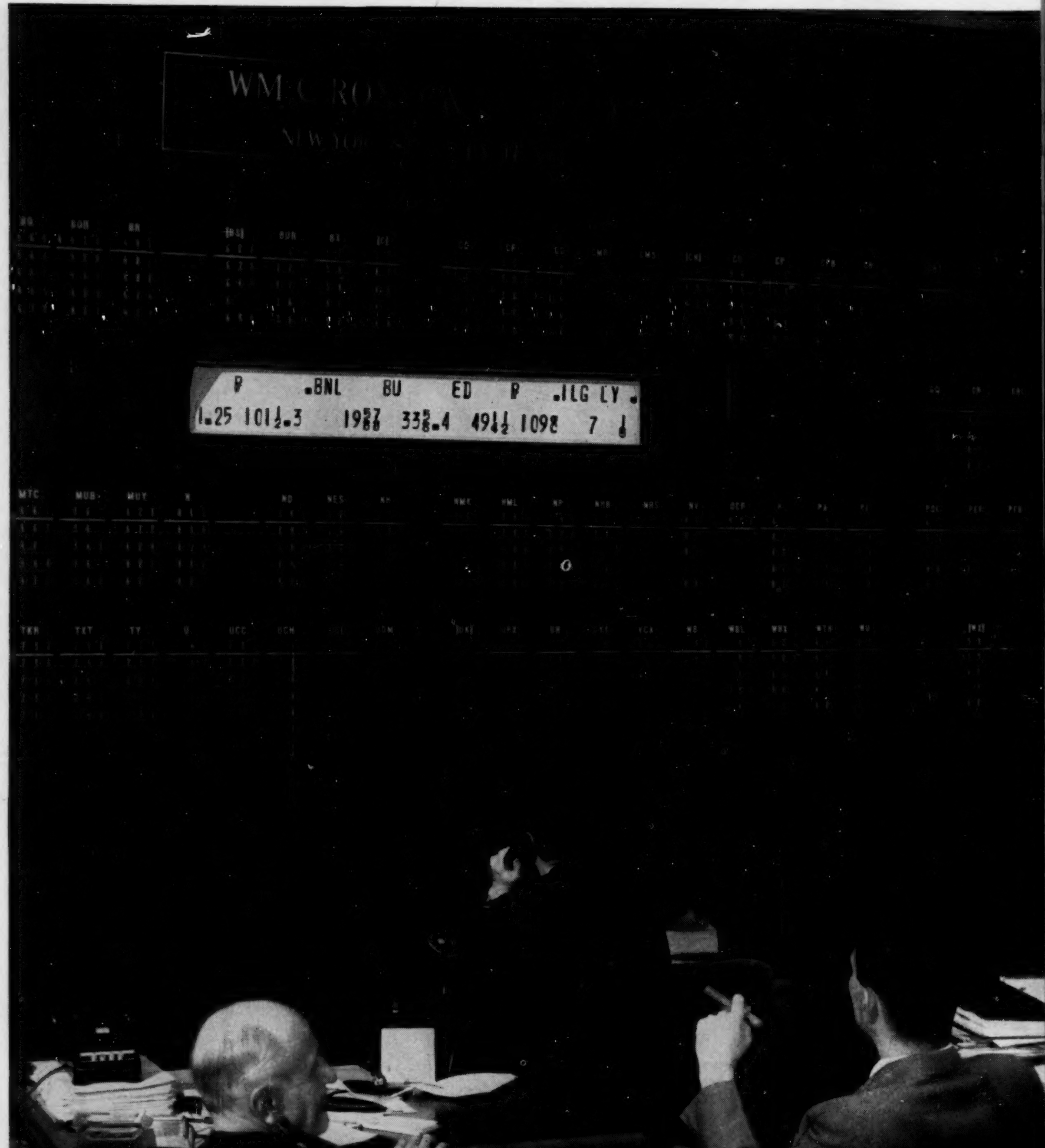
Sulfuric Acid/Africa: Operations are now under way at the new $5.6-million acid plant of African Explosives and Chemical Industries in Natal. The plant, which includes facilities for burning pyrites, will produce sulfuric acid by the Petersen process.



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GEORGE COKER

BM PHOTOGRAPHY, BEAUMONT

RISING CHEMICAL CENTER: At Beaumont, long chain of events—plus oil, water and sulfur—spurred building of . . .

Petrochemical Palace in Oil's Front Yard

Since 1901, oil has been king in the formerly rice-growing bottom lands between Beaumont and Port Arthur in southeast Texas.

But in the past 14 years, chemicals have moved in. Chemical and petrochemical expansion has been accelerating, and still more resources are waiting to be tapped.

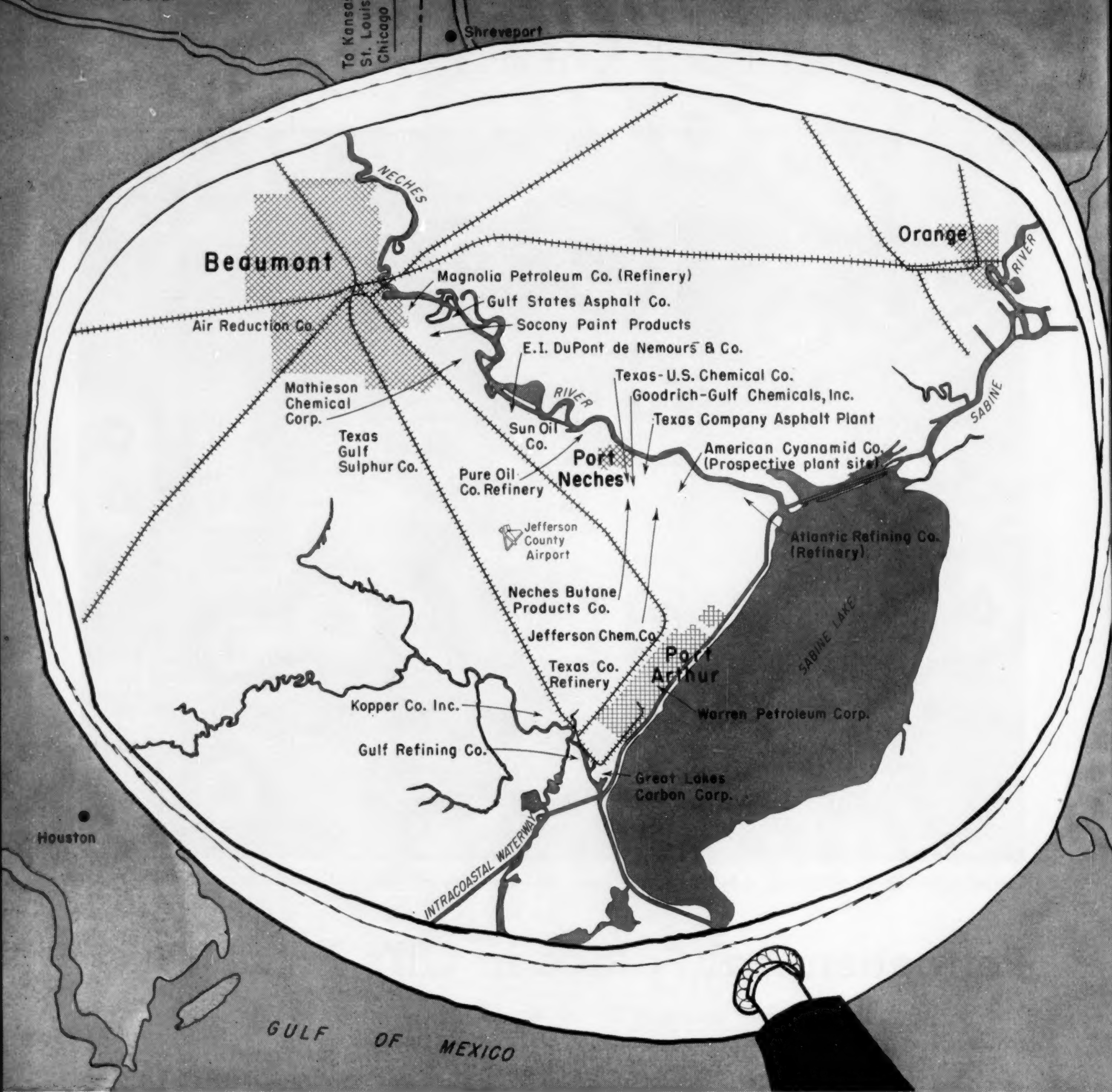
THEY TOOK a long time to get going, but chemicals are now well established as the fastest-growing industry in the oil-rich Beaumont-Port Arthur area of Texas' Gulf Coast, outranked only by petroleum itself as the community's biggest money-maker.

This 16-mile stretch along the lower reaches of the Neches River—scene of the nation's first great oil field strike—contains nearly 11% of U. S. oil refining capacity. But for many years after Gulf Oil's predecessor company brought in the famous gusher at Spindletop just south of Beaumont in 1901, the area had virtually no chemical industry.

Oil was king. But with prices bouncing erratically between a high of 50¢/-bbl. and an all-time low of 5¢/bbl., the companies that later became The Texas Co. and Gulf Oil Corp. decided to build refineries nearby to assure producing companies a fair price and steady market. Other companies, too, soon built refineries there (*see map*). Then ship channels were dredged, opening much of the area to ocean traffic.

Enter Chemicals: With both a big market (the oil refineries) and a big source of raw material (sulfur deposits) close at hand, Southern Acid & Sulphur Co. decided to build contact sulfuric acid plants here. One went into operation at Port Arthur in 1918, the other at Beaumont in '30. These plants—now owned by Olin Mathieson—are still in production.

But the next important chemical development in the area didn't come until 1942. Because of the war, the U. S. found its industrial base crimped by lack of new rubber.



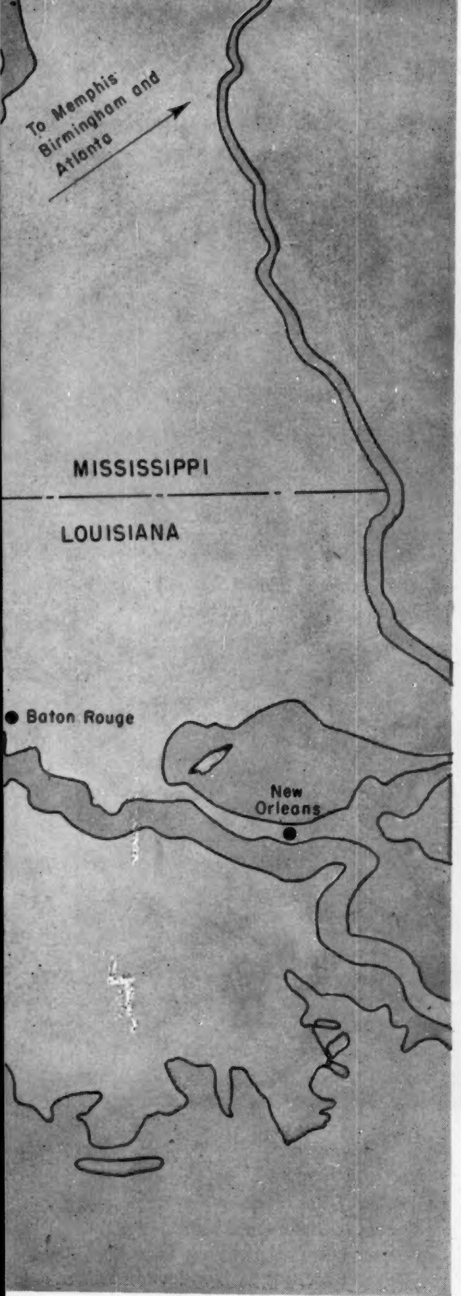
Bottleneck in projected production of synthetic rubber was butadiene. In March of that year, Port Neches was selected as the site for a large butadiene plant, largely because of its proximity to five refineries that could supply feedstock. The owners of those five plants—Atlantic Refining, Magnolia Petroleum, Gulf Oil, Pure Oil and The Texas Co.—then organized the Neches Butane Products Co. to design, construct and operate the plant for the government.

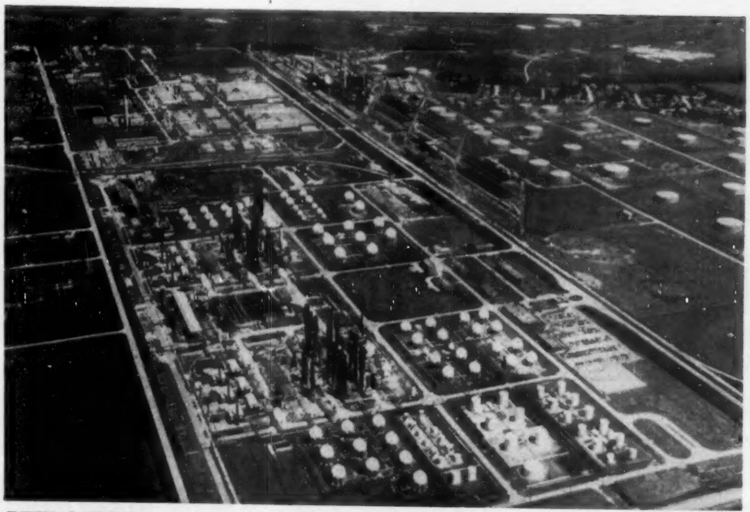
World's Largest: This plant—which went onstream early in '44—grew from the original design capacity of 100,000 tons/year to its present demonstrated capacity of 180,000 tons/-year, largest in the world. It was sold by the U. S. government last year to Goodrich-Gulf Chemicals and Texas-U. S. Chemical Co.

Built on adjacent sites during World War II were two copolymer plants. One was operated first by Firestone Tire & Rubber, then by Naugatuck Chemical Division of United States Rubber Co., and is now owned by Texas-U. S. Chemical Co. The other was built and operated by B. F. Goodrich Chemical Co., has now been sold to Goodrich-Gulf Chemicals.

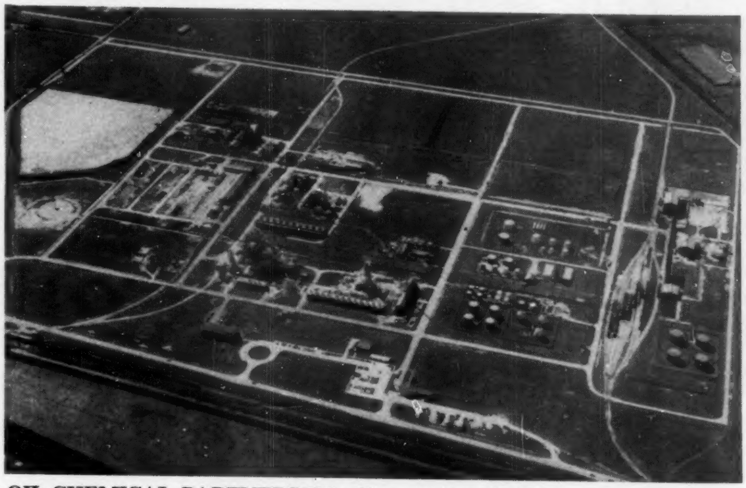
Present petrochemical development in this area is based entirely on private capital. This stage began in 1944 when Texaco and American Cyanamid formed Jefferson Chemical Co. to produce a variety of petrochemicals, using petroleum gases, chlorine and lime. The plant—built on an 1,100-acre plot near Port Neches—came in '48, has been expanded twice.

ADMINISTRATION. . . . .

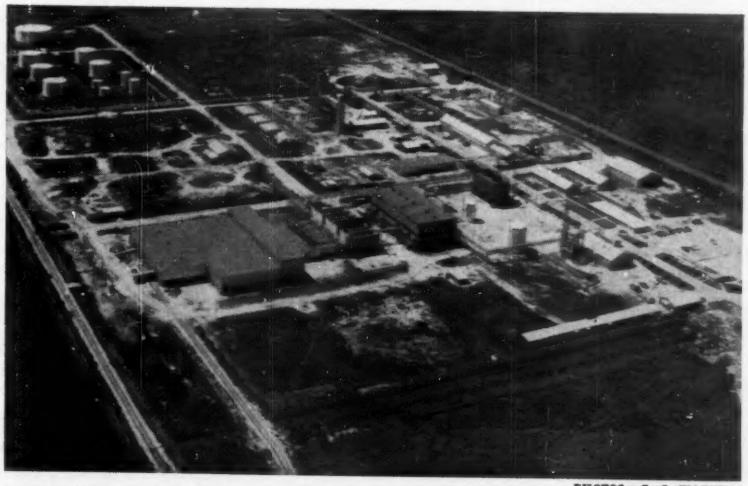




PETROCHEMICAL PIONEERS: Port Neches' butadiene, copolymer plants.



OIL-CHEMICAL PARTNERSHIP: Also at Port Neches, Jefferson Chemical.



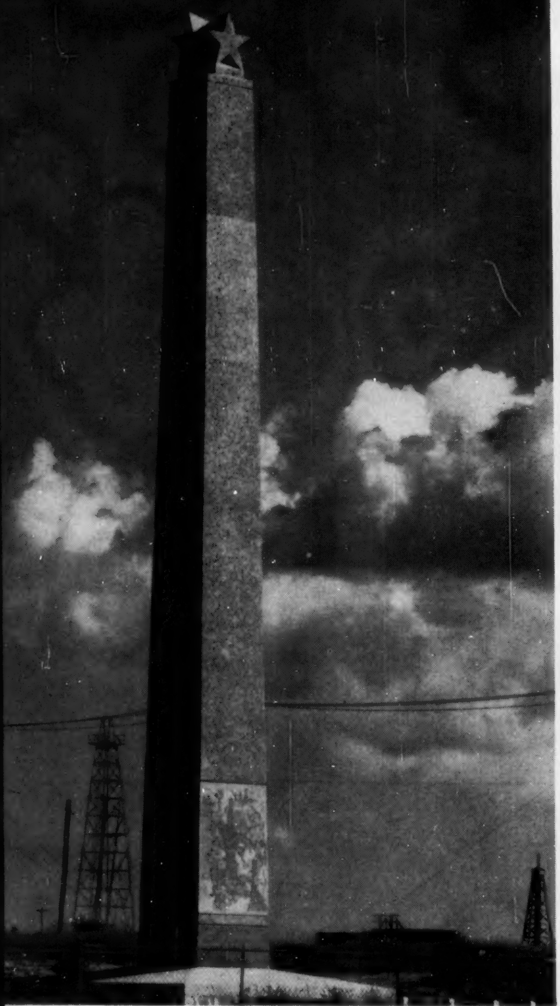
PHOTOS—J. C. WATKINS

NEWEST IN PLASTICS: In foreground, Koppers' new polyethylene unit.

Ethylene Era: With Gulf Oil producing ethylene for sale at its huge Port Arthur refinery, Koppers Co.'s Chemical Division bought a 1,026-acre tract nearby and completed a plant three years ago to make ethylbenzene—a styrene intermediate—by combining that ethylene with coal-tar benzene from Pittsburgh. A year later, Koppers decided to add a polyethylene unit at Port Arthur; production began last October.

Du Pont—already familiar with the area because of its operations at

Story begins on p. 27



BM PHOTOGRAPHY, BEAUMONT

SPINDLETOP MONUMENT: Where wildcatters' gusher started oil, chemical booms.

J. C. WATKINS

RUNNER-UP IN SIZE: Gulf Oil refinery, called second largest.

MARKET STABILIZER: The Texas Co.'s Port Arthur works.

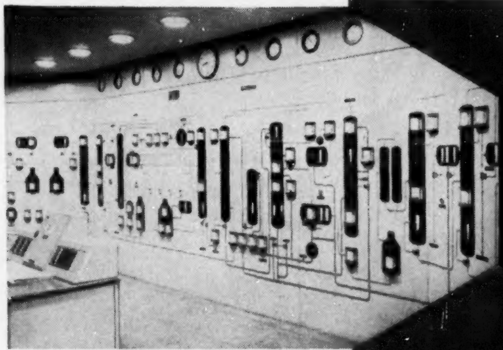
Orange, Tex., just 26 miles away—joined the new chemical club in '53 by buying a 600-acre site four miles southeast of Beaumont. There it produces methionine for use as a poultry feed supplement.

Other process plants nearby are Great Lakes Carbon at Port Arthur (making carbon from petroleum coke) and East Texas Pulp & Paper at Evadale (owned by Time, Inc., and making 300 tons/day of kraft products).

Much More to Come: Many expansion and development moves are on the drawing boards. In public works, Congress has authorized construction of McGee Bend Dam on the Neches River above the four-year-old Dam B, which is about 35 miles north of Beaumont; this will mean an additional 4 million acre-feet of water storage. And port modernization programs at both Beaumont and Port Arthur include building of new wharves.

Heading the industrial expansion list is Gulf Oil's plan—announced last week—for installation of a third ethylene unit at its Port Arthur works. Magnolia Petroleum is undertaking a $25-million expansion at its Beaumont refinery; and the recently organized Aviation Fuels Co. expects to build a plant near that city. Texas-U.S. Chemical is boosting capacity at its copolymer plant to 275 million lbs./-year; and Du Pont's unit for production of chlorosulfonated polyethylene (Hypalon) is scheduled to start up in the first half of next year. American Cyanamid has acquired a large site adjacent to Jefferson Chemical's plant, but hasn't started building on it.

Oil and natural gas production will continue unabated for many years, with long pipelines radiating out to supply Beaumont's refineries from rich fields in east and west Texas, Oklahoma and Louisiana. Water is plentiful, and sulfur mining is going strong. (As a matter of fact, Spindletop's sulfur deposits are expected to bring in about as much revenue as has come from its lucrative oil wells. In addition, there are undeveloped salt domes at Spindletop, Big Hill and Fannett, all in Jefferson County. The upshot seems clear: industry's a long way from closing the books on chemical growth in this community.



OPERATIONAL CONTROL *of Cosden's aromatics plant centers around this graphic panel, which indicates and records each phase of the entire manufacturing process. Such control enables Cosden to guarantee aromatics which are always of premium quality.*

B T X

benzene

ACS Reagent Grade Specifications
ASTM D835-50, Nitration Grade (1°)
ASTM D836-50, Industrial Grade (2°)
Federal Specification VV-B-231a

toluene

ACS Reagent Grade Specifications
ASTM D841-50, Nitration Grade (1°)
ASTM D842-50, Industrial Grade (2°)
ASTM D362-36, Industrial Grade (PV&L)
JAN-T-171 Specifications
Federal Specification TT-T-548a

xylene

ASTM D846-50, Ten Degree
ASTM D364-36, Industrial Grade (PV&L)
Federal Specification TT-X-916, Grade A

Produced at Big Spring, Texas, by one of the world's largest independent inland refineries, Cosden aromatics possess properties far exceeding those stipulated under the most exacting industrial specifications. Of superior stability and solvency, they contain no detectable non-aromatic impurities or sulfur compounds.

chemical COSDEN division

Organic Chemicals Division ■ *Cosden Petroleum Corporation, Big Spring, Texas*

✱ distributors in principal Midwest cities

Western Front Next

Undaunted by the recent out-of-court settlement with Pfizer that bolstered the standing of Ferment-Acid Corp.'s (New York) citric acid process patent, Miles Laboratories (Elkhart, Ind.) is girding this week for a stout defensive fight in the sequel suit on alleged infringement of that patent.

Miles says it doesn't believe it's infringing on the 12-year-old patent, is turning down last month's offer by Ferment-Acid to settle on terms similar to those accepted by Pfizer.

Faced with Miles' nonyielding attitude, attorneys for Ferment-Acid are preparing to prosecute this second suit, either in New York (where they filed the complaint 18 months ago) or in South Bend, Ind. (where Miles wants the action transferred).

The cases arose over Ferment-Acid's U.S. Pat. No. 2,353,771 covering the "submerged fermentation" citric acid process. Ferment-Acid, a 14-year-old research and development company, has had its chief chemist, Hungarian-born Joseph Szucs, working on various fermentation processes since he came

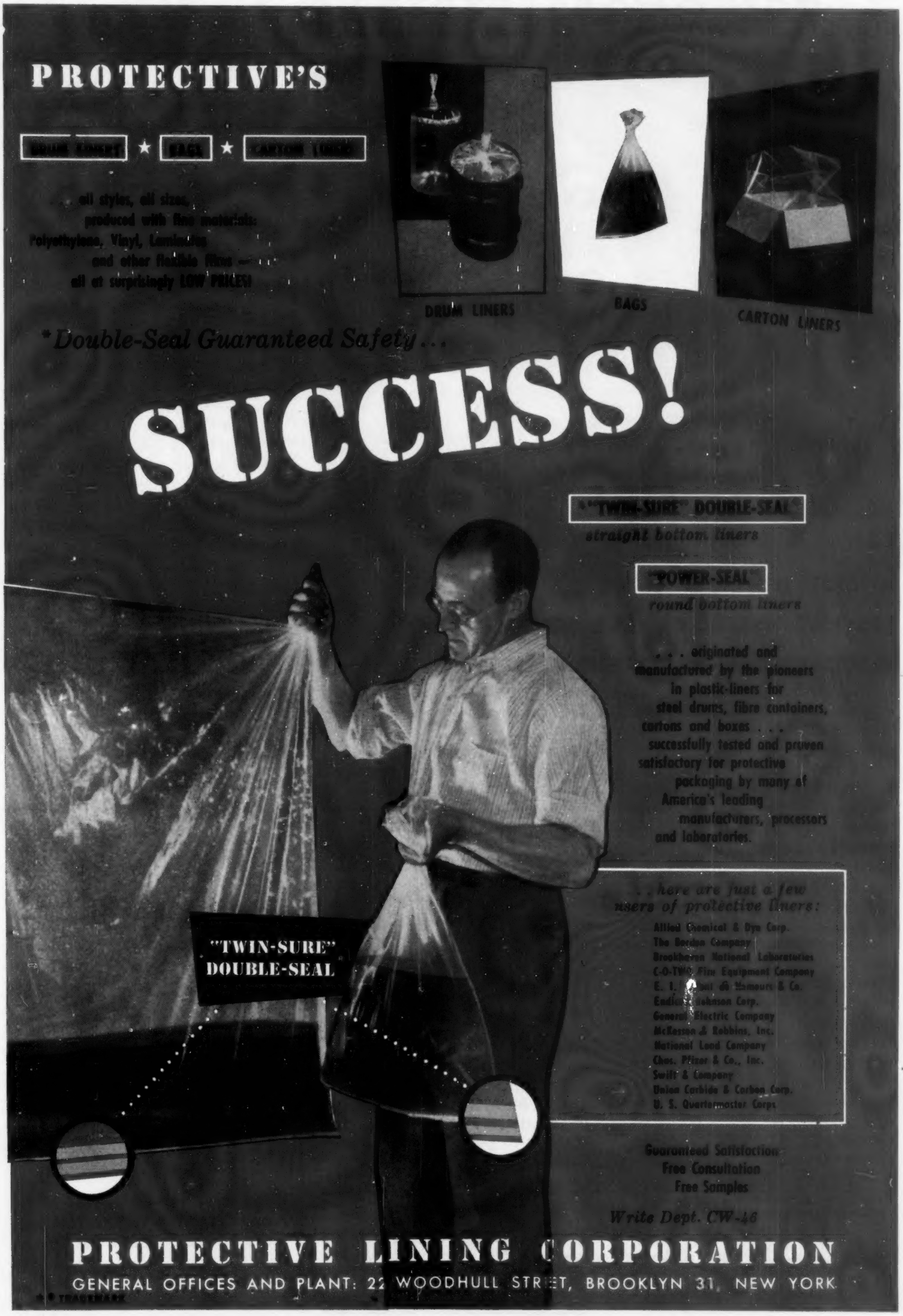
Hand in Hand for Science

SPEARHEADING a lively movement in the search for engineering talent, chemical companies in Pekin, Ill., last week helped industry and education present jointly the second annual Pekin Science Fair. Thirty-one businesses, industries and technical societies displayed process equipment and techniques, while more than 250 science students of Pekin High School displayed their individual class projects based on school science courses.

Sponsored by the Pekin Assn. of Commerce and the Board of Education, the fair brought together actual applications of industrial science and inventive outgrowths of students' science training. Put side by side, the displays demonstrated the multitude of practical paths science interests can take. More than 6,100 people witnessed the displays.

Among industrial displays were those of the American Distilling Co., The Borden Co., Corn Products Refining Co., and Standard Brands, Inc. More than a dozen engineering and professional societies also contributed, and the Assn. of Commerce provided manpower, space and booths.

How many of the youngsters will continue in science study is an open question. But Pekin industry and education groups feel they've taken a constructive step in stimulating interest in scientific careers.



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* TRADEMARK

ADMINISTRATION . . .

to this country in 1941. Most of his work has been done at the Boyce-Thompson Institute for Plant Research in Yonkers, N.Y., and F-A credits him with having developed both the "pan method" and "deep fermentation" process of citric manufacture.

In its original complaint, filed in New York in 1954, F-A asked for: an injunction against further infringement; an accounting of actual damages, this amount to be tripled, or lump-sum damages in the amount of $1 million; court costs and attorneys' fees.

The Pfizer case was terminated in a consent judgment issued by Judge Robert Anderson of U.S. District Court of Connecticut. The agreement was reached without liability on the part of either party to the other. Says Pfizer, "The two companies agreed to release each other from any liability arising out of a contract entered into in 1944, which pertained to a process for the production of citric acid by submerged fermentation." Pfizer will pay $220,000 for use of the patent during its remaining five years, has acknowledged the patent's validity.

In the suit against Pfizer, which sought $5 million for alleged infringement, Ferment-Acid claimed Pfizer was using confidential information furnished by Ferment-Acid during a 16-month period in 1944-45 when Pfizer was investigating the "deep fermentation" process. The contract provided that chemist Szucs would help Pfizer chemists test his process, and that Pfizer would have an option to buy a license if the government issued a patent on the method.

The patent was issued on July 18, 1944, but Pfizer did not exercise its option. Instead, Ferment-Acid charged in its suit, Pfizer secretly utilized "the principles, data, know-how and other detailed information" disclosed to Pfizer during the investigation period. According to Pfizer, its investigation had shown that the process was not suitable, and its contract with Ferment-Acid was allowed to expire.

LEGAL . . . .

Litigation Echoes: Shades of the famous 1941 Wilson Strickland land-ownership case against the Humble Oil & Refining Co. have arisen from the filing of a suit by L. V. Strickland, and others, against seven oil and

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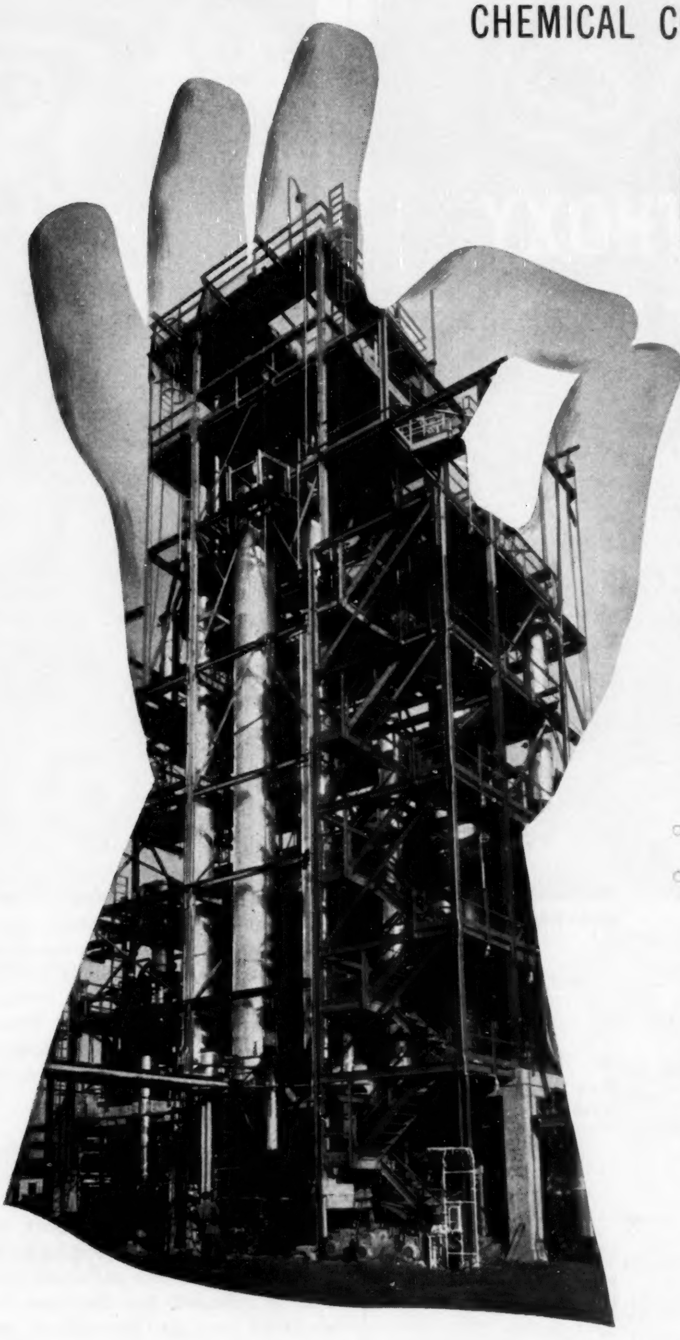

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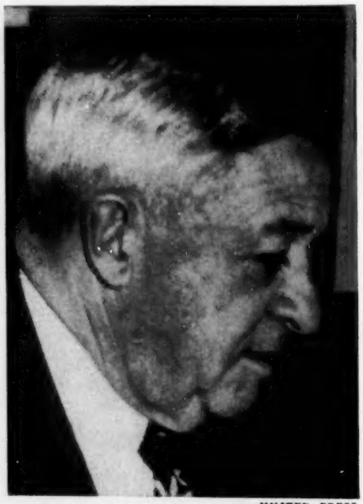


UNITED PRESS

JUDGE CONGER: After a six-day trial, no consequential damages.

petrochemical companies for an aggregate of \$100 million. The charge in second district court of Montgomery County, Texas, is that Mon-Sho Oil Co., Humble Oil & Refining Co., Skelly Oil Co., Tidewater Associated Oil Co., Sun Oil Co., and the Texas Co. are operating oil and gas wells on a "third of a league of land" owned by Strickland and some 1,200 other plaintiffs in the heart of the Conroe Oil Field. Strickland bases the complaint on a State of Texas "patent" recorded in Montgomery County clerk's office, which assertedly establishes that the land was given to an earlier Wilson Strickland by the Republic of Texas in 1841. In 1940-41, an 11-month case between Wilson Strickland and Humble Oil, based on the same contention, was lost by Strickland.

•

Warranty Consequences: Can shutdown losses resulting from equipment failures be claimed as damages? A federal court jury in New York has answered in one chemical industry case that replacement and repair costs can be collected, but not losses for shutdown time. The jury gave its verdict on a case between Hatco Chemical Co. (Fords, N.J.) and Superior Combustion Industries, Inc. (New York) after a six-day trial before Judge Edward A. Conger. The case stemmed from Hatco's 1953 purchase of a generator and condensate tank; Superior warranted the latter suitable

WIDE WORLD

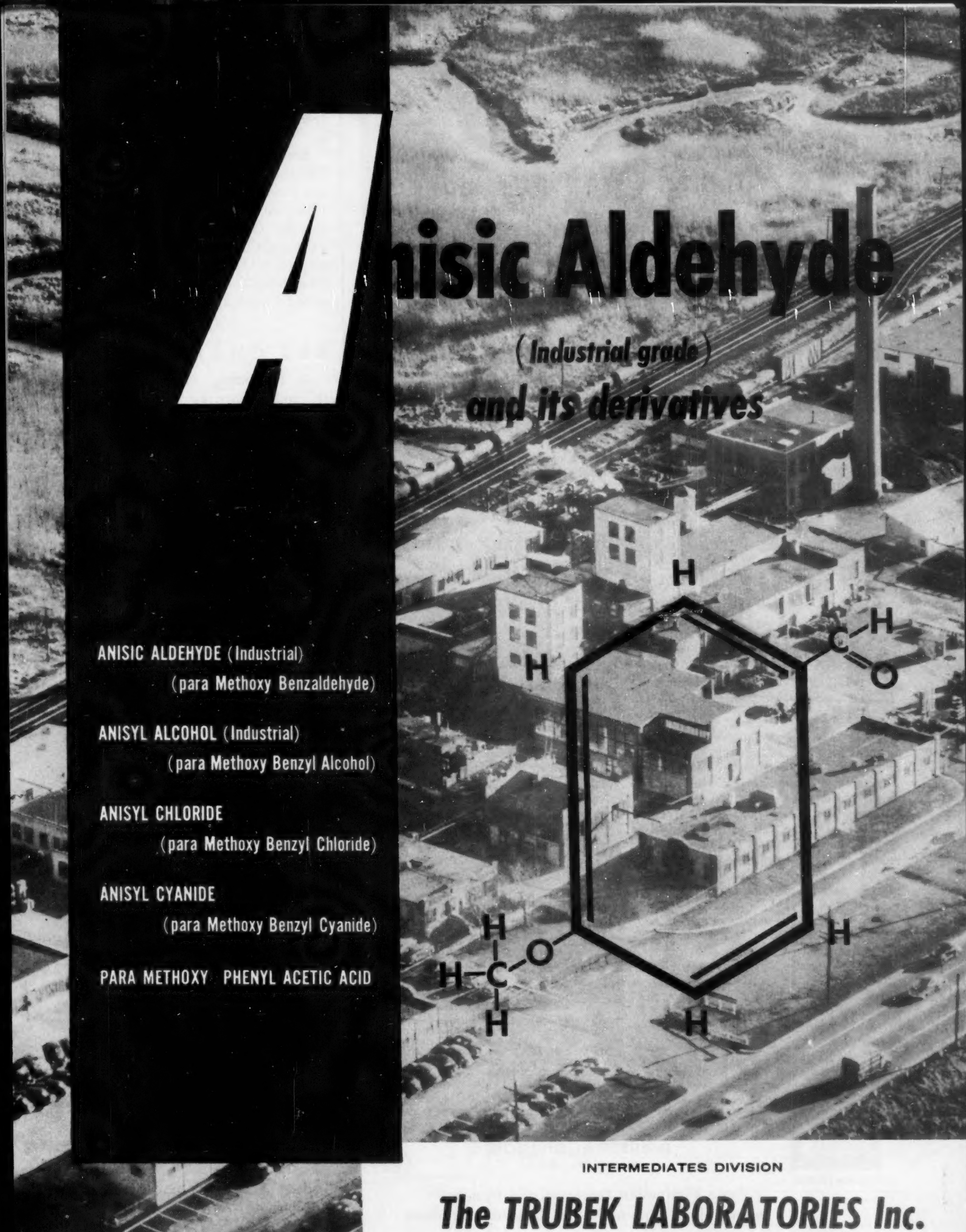
U.S. STEEL'S BLOUGH: In wage-price spiraling, he accuses unions.

for Hatco's use, but—according to Hatco—the tank didn't hold up. Hatco sued Superior for $12,731, a combination of repair and replacement costs for both pieces of equipment amounting to $3,730, plus $9,000 for losses due to operational shutdowns resulting from failure of the generator. The jury's verdict: $2,308 for tube failures and inadequacy of the tank.

LABOR . . . . . .

Blame for Inflation: Out in the open this week is the hassle over who's most to blame for continuing inflation. In his first report to stockholders, U.S. Steel's Chairman Roger Blough said his company's price increases last year were made necessary largely by higher employment costs; he went on to state that one basic root of the inflationary tendency is the institution of industry-wide labor unions headed by leaders who "seek always to outdo each other in elevating employment costs in their respective industries."

This brought an angry retort from President David McDonald, of the United Steelworkers (AFL-CIO), who accused U.S. Steel of making a profit on last year's 15¢/hour steel wage increase. McDonald figures that pay hike cost the company about $30 million in '55, but that higher steel prices brought in some $96 million more than would have been taken in under the 1954 price schedules. (However, Blough made it clear that mounting costs of materials, taxes, and equip-


Anisic Aldehyde
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ANISIC ALDEHYDE (Industrial)
(para Methoxy Benzaldehyde)
ANISYL ALCOHOL (Industrial)
(para Methoxy Benzyl Alcohol)
ANISYL CHLORIDE
(para Methoxy Benzyl Chloride)
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NEW JERSEY

ADMINISTRATION . . .

ment also were factors in the '55 price rises.)

•

East Coast, West Coast: At Norfolk, Va., the International Chemical Workers Union has signed new contracts with two fertilizer makers — F. S. Royster Guano Co. and Robertson Chemical Corp. — calling for wage increases of 5-6¢/hour and additional fringe benefits. The Royster pact served to end a short strike.

KEY CHANGES . . .

D. F. Behney, James L. Weaver, Jr., and **William L. Lasser,** to directors, Harwick Standard Chemical Co. (Akron, O.).

W. N. Burding, John P. Moser and **Henry Schachte,** to directors, Lever Brothers Co. (New York).

Henry Wendt, Jr., to vice-president and general manager, Davis & Geck, Inc., division of American Cyanamid Co. (New York).

E. L. Hamilton, J. H. Shipley and **L. W. Haslett,** to vice-presidents, Canadian Industries Ltd. (Montreal).

Robert L. McNeil, Jr., to board chairman, **Henry S. McNeil,** to president, and **James A. Noone,** to vice-president, McNeil Laboratories, Inc. (Philadelphia).

Gilbert J. Straub, to vice-president, Purdue Frederick Co. (New York).

Winthrop C. Henderson, to vice-president, General Paint Co. (San Francisco).

Howard C. Greer, to vice-president, and **Arthur W. Lucas,** to treasurer, Chemstrand Corp. (Decatur, Ala.).

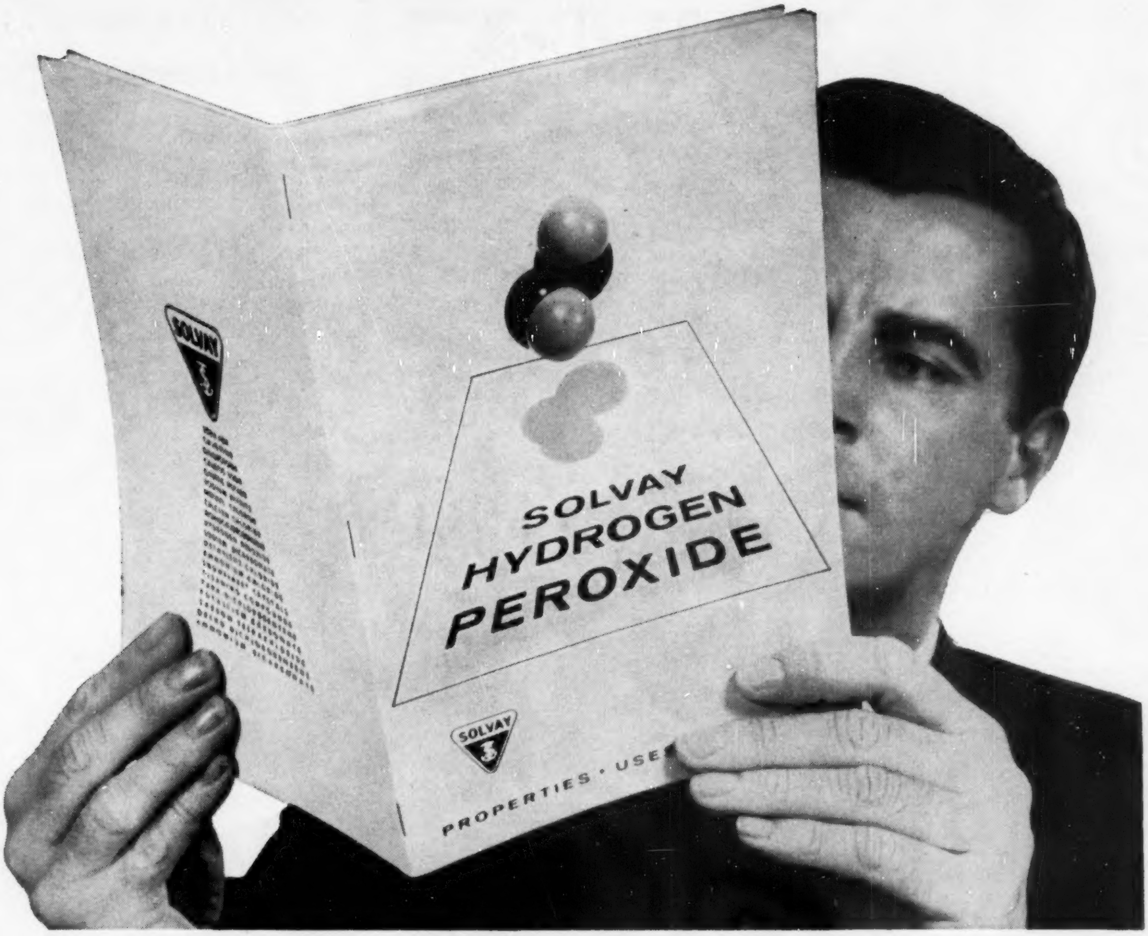
James F. Connaughton, to vice-president and director, Sterling Precision Corp. (New York).

Horace B. Van Dorn, to director, Joseph Dixon Crucible Co. (New York).

DIED . . . .

George W. Charles, director and former vice-president, Dominion Rubber Co. (Montreal) at Montreal.

Alfred A. Halden, 61, vice-president and director, National Starch Products, Inc. (New York), at Scarsdale, N.Y.



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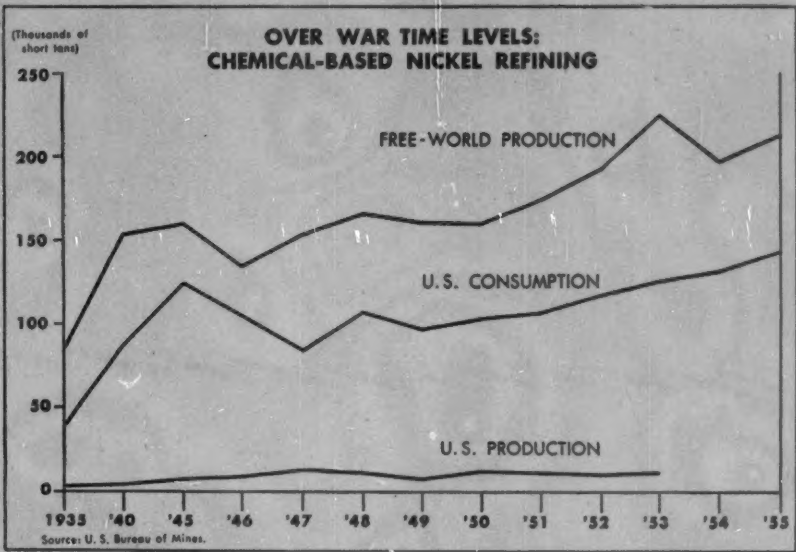
CHEMICAL PROGRESS WEEK-APRIL 23-28

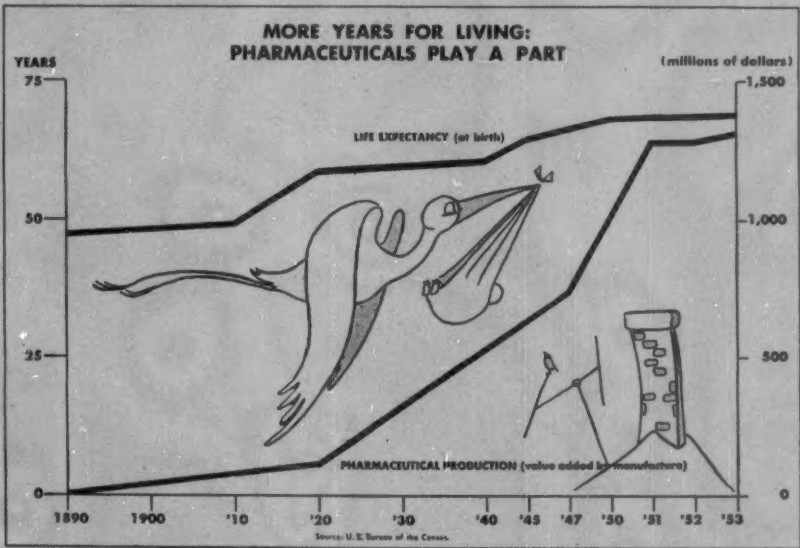
ORONITE CHEMICAL COMPANY

Charting Business

CHEMICAL WEEK
April 7, 1956



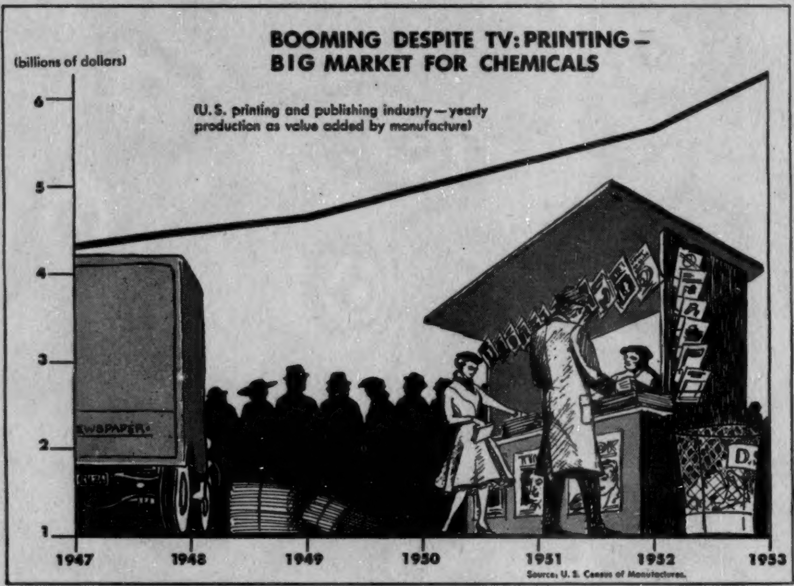
GOBBLING UP all the nickel available—including whatever is released periodically from government stockpiles—U.S. industry is by far the largest free-world market for this corrosion-resistant metal. And estimated U.S. consumption this year again will be more than double the prewar level. In turn, production of nickel—more than 70% of the free-world supply comes from Canada—constitutes an important market for certain industrial chemicals. Among chemical products used in refining nickel ore: sodium sulfide, dilute sulfuric acid, calcium sulfate, limestone, ammonia, and ammonium carbonate.



FOR MORE than 50 years, the average life span in the U.S. has been lengthening steadily, is now more than 20 years longer than life expectancy at the turn of the century. One major factor: ever wider and wiser use of an increasingly effective battery of drugs, medicines and antibiotics produced by U.S. pharmaceutical companies. Properly used, these products build up resistance or immunity, kill disease-causing organisms or stop their growth, and otherwise shield humanity from oft-fatal diseases that used to be common.

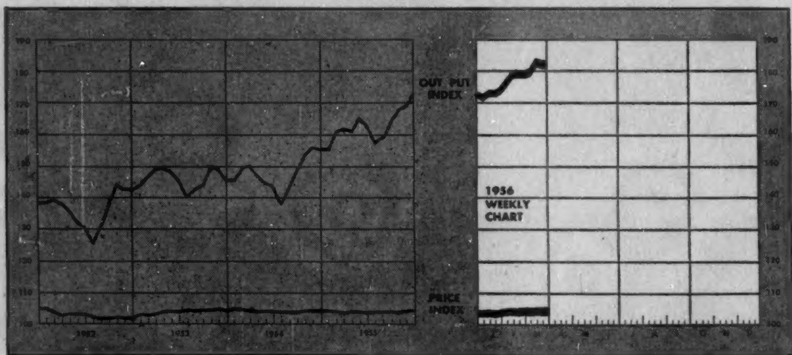
Charting Business

(Continued)



TELEVISION, the movies, and hi-fi phonographs haven't kept people from stepping up their reading. As a matter of fact, the printing and publishing industry—including books, magazines and newspapers—is booming, with output rising to a new record height each year. These are pleasant tidings to many chemical process companies, which—with many kinds of specially treated papers, inks, pigments, solvents and numerous other items—have been supplying the nation's printers with more than $100 million worth of goods a year.

BUSINESS INDICATORS



WEEKLY	Latest Week	Preceding Week	Year Ago
Chemical Week Output Index (1947-49=100)	183.2	183.0	162.7
Chemical Week Wholesale Price Index (1947=100)	105.7	105.6	104.1
Stock Price Index of 11 Chemical Companies (Standard & Poor's Corp.)	497.6	499.6	367.1

MONTHLY—Production (Index 1947-49=100)	Latest Month	Preceding Month	Year Ago
All Manufacturing and Mining	144	143	135
All Chemical Products	182	178	162
Industrial Chemicals	205	199	177

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Successful practitioners of the goldfish-bagging art name two requisites. The bag must hold water; and it must permit air to pass through its walls. In other words, the bag must behave like polyethylene.

Because polyethylene keeps vegetables fresh by letting them breathe, it is one of our most useful packaging materials. It gets a healthy assist from an *antioxidant* developed by Shell Chemical—Ionol.®

It is Ionol in the mix that imparts to polyethylene its ability to weather high temperatures during initial milling of the film. It is Ionol that helps keep it tough during years of wear.

Ionol in paperboard, too, combats rancidity in packaged cakes and cookies. And it is Ionol, added directly to vitamin concentrates, lard and shortening, that greatly lengthens shelf life.

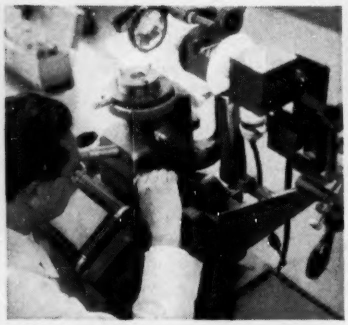
The making of Ionol, an antioxidant of many uses, is another of Shell Chemical's contributions to the packaging and food processing industries.

Shell Chemical Corporation

Chemical Partner of Industry and Agriculture

NEW YORK

Owens-Illinois Assures You A



Co-ordinated Research

Pure research into formulae and fabrication of glass, *packaging research* into processing and handling methods in customer plants, and *market research* into consumer attitudes, add up to greater specific value for your packaging dollar.

Engineered Design

The package that takes your product to market must take *three* needs into account. Considerations of its function in the retail store, its operating efficiency and its consumer utility all become a part of the prescription for an Owens-Illinois package.

The Right Container

Facilities at Owens-Illinois are versatile. Talents are varied and many. So you can count on obtaining a container exactly suited to your needs—one that blends salesmaking beauty, product protection and utility in the proportions required to attract customers.

Air Freshener or Disinfectant—

Complete Packaging Approach

The Right Closure

Know-how as to the best available liner and closure—best for packing, displaying, or using a specific product—may well be one of the most important single points through which expert packaging counsel will reward you many times over.

Needed Fitments

With emphasis on the word "needed," Owens-Illinois specialists are keenly aware of sales benefits possible through use of plastic shaker and pour-out fitments which are not "gadgets" but which increase consumer satisfaction with your product.

Merchandising Cartons

Modern cartons are developed only through systematic consideration of their opportunity to serve you in the retail store and retail warehouse as well as on your own filling line and in transit. Owens-Illinois is pioneering such developments.

help yourself to sales...

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Impulse buying plus product recognition is largely responsible for the record increase in store sales.

Marketing your product in a well-designed and engineered glass container puts your merchandise up front in the sales parade.

Glass can be designed and molded into a salespackage to catch the customer's eye in advertising campaigns as well as in the store where sales are made. Glass also is an efficient salesman when it comes to convenience and product protection. The quality of the contents is maintained throughout many openings and closings. The housewife can readily see how much she has left.

Skilled packaging designers at Owens-Illinois will gladly help you create a sales-making label and closure combination for your product. There are hundreds of different sizes, styles and shapes of stock-model bottles from which you can choose.

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The precautions taken to protect caustic soda are typical of the features that General American builds into tank cars. If you ship liquids in bulk, there's a General American car that's built or can be built to meet your needs. To learn how GATX tank cars can help you, call or write your nearby General American district office.

typical products successfully shipped in GATX insulated tank cars • *Molten Sulfur* • *Wax* *Asphalt* • *Phthalic Anhydride* • *Wine* • *Rosin* • *Latex*

features of GATX insulated tank cars* *All-Welded Tank, Jacket and Underframe* • *Flued Dome Construction* *Insulation and Heating Coils* • *Choice of Interior Linings (Available)* *Safety Dome Platform (Available)* • *One-Piece Longitudinal Bottom Plate* • **Standard equipment unless otherwise noted*

GATX GENERAL AMERICAN
TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street • *Chicago 90, Illinois*

PRODUCT MANAGERS coordinate management functions to help sales . . .

KNOWS the customer's needs as thoroughly as those of his own firm.

MAKES small-business service (e.g., car diversion) easier for big firms.

Keep That Personal Touch

What can a product manager setup do for you as mergers mount and industry gets ever bigger and more complex? The answer: plenty—if you're struggling to keep the personal touch in customer relations as your sales head for new peaks; plenty—if you're striving to balance production and sales and stock your customers' inventories.

That's the belief of Olin Mathieson's Ken Frazier, manager of inorganic sales for the firm's industrial chemical division. Frazier gives OM's product managers a big share of the credit for the firm's spectacular growth.

Essentially, the industrial chemical dvision's six product managers are "integrators de luxe."

They must know all there is to know about the production, sale, application, packaging, transportation and servicing of chemicals in their group.

And this must be matched with an equally comprehensive knowledge of major customers—their requirements, manufacturing process, accessibility, storage facilities, etc. With all this knowledge (*see box, p. 50*), and with the necessary authority, the product manager can get his main jobs done:

- Ensuring that delivery promises are rigidly kept.
- Adjusting sales to production.

Case in point: a customer whose regular shipment is delayed en route. Cognizant of all aspects of order expediting and of the accounts carrying sufficient inventory to permit diversion of their orders to the distressed account, the product manager can switch a tank car to meet the necessary delivery date, and instruct a plant to dispatch a replacement for the diverted car. This, Mathieson finds, is a "personal" way to keep reorders coming in.

Again, by using such know-how plus information gleaned from sales reports and orders, the product manager can balance production and sales. Result: minimized storage costs, maximum utilization of equipment.

To bridge the gaps between "bigness" and the customer, between production and sales, OM's product managers act in a staff capacity, report to sales managers, and have authority to:

- Take all steps necessary to fulfill promised delivery dates.
- Submit recommendations to production scheduling committee.
- Prepare sales budgets for product groups.

• Investigate packaging problems, submit recommendations.

• Handle complaints, make adjustments.

• Make purchasing suggestions.

• Compete for the sales force's time. The six product managers use essentially the same sales force. The interest salesmen show for particular products is stimulated largely by the product manager.

OM's product manager system hasn't made sales managers obsolete. The division sales managers function at the field level, perform all the usual duties of scheduling sales calls, figuring strategy, gathering information, preparing reports, checking on delivery dates.

Since its inception at Mathieson several years ago, product managers have grown in scope and ability. Part of Mathieson's plan to meet the future, they are, as Frazier puts it, "an important and integral part of our growth and development."

Service Needs Knowledge: What Product Managers Must Know . . .

	About Olin Mathieson	About Customer
To expedite orders	Day-by-day production of factories; location of shipments in process; inventory size; transportation equipment availability; feasibility of supplying from other plants.	Products bought; quantities; where consumed; storage facilities; inventory on hand; transportation lines suitable; routing; travel time; rate of product use.
To schedule production	Raw material supply; production method; daily plant output; plant capacity; maintenance situation; plant personnel; what to recommend to the scheduling committee; demands on plant to make other chemicals.	Long- and short-term needs; ability to use alternative forms of product (different pellet size, concentration, etc.); competition of and for the customer; frequency of purchase; seasonableness.
To budget sales	Sales organization; staff; distribution costs; customer distribution; breakdown of sales volume; promotion and its cost.	Need for frequent service calls; problems demanding service; profitability of items sold to account.
To specify packaging	Current packaging operations; developments in containers and suitability for company products; number of customers who might benefit; costs; labeling.	Packaging currently used; materials handling and storage facilities; potential advantages to customer; what competitors are offering.
To process orders	What customers are ordering; how to spot trends immediately; how to use sales reports, handle complaints, work with data processing department.	Purchasing influences; procurement idiosyncrasies; complaint sources; customer procedure; personal contacts.
To update sales staffs	If products are adaptable to new uses, competitive activity; all new applications; how to compete for selling effort of staff.	Who could use new applications; what information is most valuable to them; benefits to customer; potential volume and profit.
For advertising	Product information; acceptable slants; promotion techniques.	Customer reading habits; whom to aim advertising at; customer needs to appeal to.
For procurement	Raw material needs; current purchase pattern; value of supply sources.	Products Olin Mathieson could buy; desirability of customer as supplier; potential impact of such policy on sales.

Celanese* acetyl production *delivers*— for all industries

Celanese, dependent only on natural petroleum sources and Celanese-produced intermediates, can synthesize every important acetyl chemical and produce it in continuous volume.

Our two plants—at Bishop and Pampa, Texas—are a dual dependable source for all industries that need acetic acid, acetaldehyde, or any other acetyl. As new acetyl chemicals become commercially useful, Celanese is in a basic position to make them available in commercial quantities.

Consequently, if acetyls figure in your formulation, make us your volume source.

Celanese Corporation of America,
Chemical Division, Dept. 552-D,
180 Madison Avenue, New York 16.

Celanese* CHEMICALS

*Reg. U. S. Pat. Off.

ACETIC ACID · ACETALDEHYDE · ACETIC ANHYDRIDE · ACETONE · n-BUTYL ACETATE · n-PROPYL ACETATE

Millions Are at Stake As . . .

- **Joint barge-rail rate case hits Supreme Court.**
- **Sulfur is issue, but water-rail precedent may be set.**
- **Here's rundown on what it means to you.**

THE BARGE and railroad companies are at it again. This time, in front of the Supreme Court, they're arguing* whether barge lines should be granted joint rates** on sulfur that's being barge-rail-hauled from Galveston to Danville, Ill.

If barge companies win the dispute, it probably won't have much effect on sulfur movements out of Galveston—the barge-rail rate would be only 1¢/ton less than the all-rail rate. It will, however, because of the lower joint rates, allow the barge companies to offer attractive rates to many inland users of barge-hauled commodities, permit them to get a foot in the door in areas not now using barge-rail combinations.

The barge people think they're being discriminated against. The railroads think the barge companies are trying to revive an already dead cause. Shippers, who are aware of the facts, are watching with interest.

On the Surface: It looks like just another skirmish in the aged rate war between railroads and barges. But ramifications of this scrap could be industry-wide. If barge companies get the joint rates, off-water users of barge lines as well as nonbarge shippers will be affected. Joint rates will mean lower freight charges for barge-hauled commodities, almost certainly higher rates to rail-only shippers, who will have to make up, through higher freight rates, the revenue that rail companies lose to the barge lines.

Facts: Here's what's behind the fight. At present the all-rail rate for sulfur shipments, Galveston, Tex., to Danville, Ill., is $9.18/ton. The on-paper rate is $11.86, but the rails are actually charging (with ICC approval) a "depressed" or "water compelled" rate to compete with barge rates.

The barge-rail rate now in effect to haul sulfur from Galveston to Danville (via break-bulk point at East St. Louis) is $8.27. Breakdown: $5.32, barge; $2.95, rail. To this must be added a $1.50/ton handling charge for the 60-mile trip from the sulfur mines to barges at Galveston. Total: a noncompetitive $9.75/ton.

Barge lines from New Orleans have a joint rate and also unload at East St. Louis for the rail trip to Danville. For this last leg (184 miles), they pay only $2.26/ton while Galveston shippers must pay $2.95 for the same haul. And that's where the discrimination charge comes in.

Dixie Carriers and Coyle Lines, which handle Galveston barge traffic, think they should get the same treatment as other connecting lines at St. Louis—call local rate they must pay "tributory." They claim that it's a violation of the section 4(3) of the Interstate Commerce Act, which states that carriers subject to the act "shall not discriminate in their rates, fares and charges between connecting lines, or unduly prejudice any connecting line in the distribution of traffic that is not specifically routed by the shipper." Both American Barge Line and Federal Barge Line, though they now enjoy the lower New Orleans-to-Danville joint rate, agree that there's discrimination, have joined forces with Dixie and Coyle.

Disagreement: The ICC, however, told the Galveston group that they were not competing carriers in the meaning of their rules, that it found "no basis" for charges of discrimination, that the joint rate sought by the Galveston barge operators was not found "desirable in the public interest." This was backed up by Federal District Court in Houston last February and it's on appeal of this decision that the barge lines are in the Supreme Court.

The Justice Dept., which is espousing the barge operator's cause, feels that ICC erred in its decision and told the Supreme Court, "The commission has repeatedly held that it is a violation of that provision for a railroad to

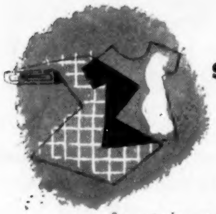
*Underlying argument involves principle, not tonnages. Original case arose over a shipment of only 20,000 tons of sulfur from Galveston to Danville, Ill. The whole case is an effort to force railroads to extend joint rates to barge lines.

**Joint rate is a rate applicable from a point located on one transportation line to a point located on another transportation line, made by agreement or arrangement between the lines, and published in a single tariff with proper concurrence of all transportation lines over which the rate applies.

HAVE YOU CONSIDERED

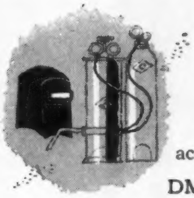
Dimethyl Sulfoxide

$(CH_3)_2S{=}O$ A MOST UNUSUAL SOLVENT



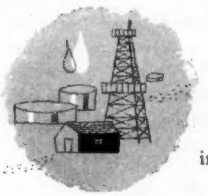
SYNTHETIC FIBERS

DMSO has excellent potential for use as a solvent in the manufacture of certain synthetic fibers. Included are polyacrylonitrile, acetate cellulose, and polyvinyl chloride. It also is a solvent for acrylic resin polymers.



ACETYLENE

Approximately 32% more acetylene can be absorbed in DMSO than in acetone. It also has a lower volatility than acetone showing promise of much longer life per cylinder charge effecting considerable overall cost savings.



PETROLEUM

Unusually selective in its solubility characteristics for hydrocarbons, DMSO can be used to particular advantage to purify, recover, or separate various petroleum products. Use as a diesel fuel additive is also indicated for raising the cetane number.

...AND MANY OTHER USES

DMSO is a clear, water-white very hygroscopic and completely water soluble liquid. Its high boiling point, high flash point and low freezing point (in eutectic mixtures with water) indicate such other uses as anti-freeze and hydraulic fluid. Other possibilities are as a paint remover, insecticide synergist, and solvent for a number of gases.

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refuse to establish joint rates with one of two connecting water carriers or with one of two connecting railroads while maintaining such rates with the other. It is equally discriminatory for a railroad to refuse to establish such rates with a barge line while maintaining them with a connecting railroad that competes with the barge line. Both are connecting carriers, and the economic advantage a rail carrier gains when the competition discriminated against is a barge line is just as great, if not greater, than when it is another railroad. The statutory prohibition is not restricted to rate discrimination between carriers engaged in the same form of transportation, but forbids discrimination between all connecting lines."

If the decision rendered in a similar case is considered relevant, the barge operators stand a good chance of obtaining a favorable ruling. In that case (ICC vs. Mechlin), the Supreme Court held that the Interstate Commerce Act "flatly forbids the commission to approve barge rates or barge-rail rates that do not preserve intact the inherent advantages of cheaper water transportation, but discriminate against water carriers and the goods they transport"; that Congress "has declared in unmistakable terms that the 'inherent advantage' of the lower cost of barge carriage, compared with that of railroads, must be passed on to those who ship by barge." The court also rejected the commission's "assumption that the Congressional prohibitions of railroad rate discriminations against water carriers were not applicable to such discriminations if accomplished by through rates."

New Look at Price Practice

Major changes in how the Federal Trade Commission views cost justification defense in Robinson-Patman Act cases of illegal price discrimination may be in the offing.

FTC has just issued a report by a special advisory committee appointed two years ago to study the question.

Basically, the report urges FTC to adopt a broad and flexible approach in evaluating cost justification arguments advanced by businessmen to answer charges of price discrimination. Major changes proposed:

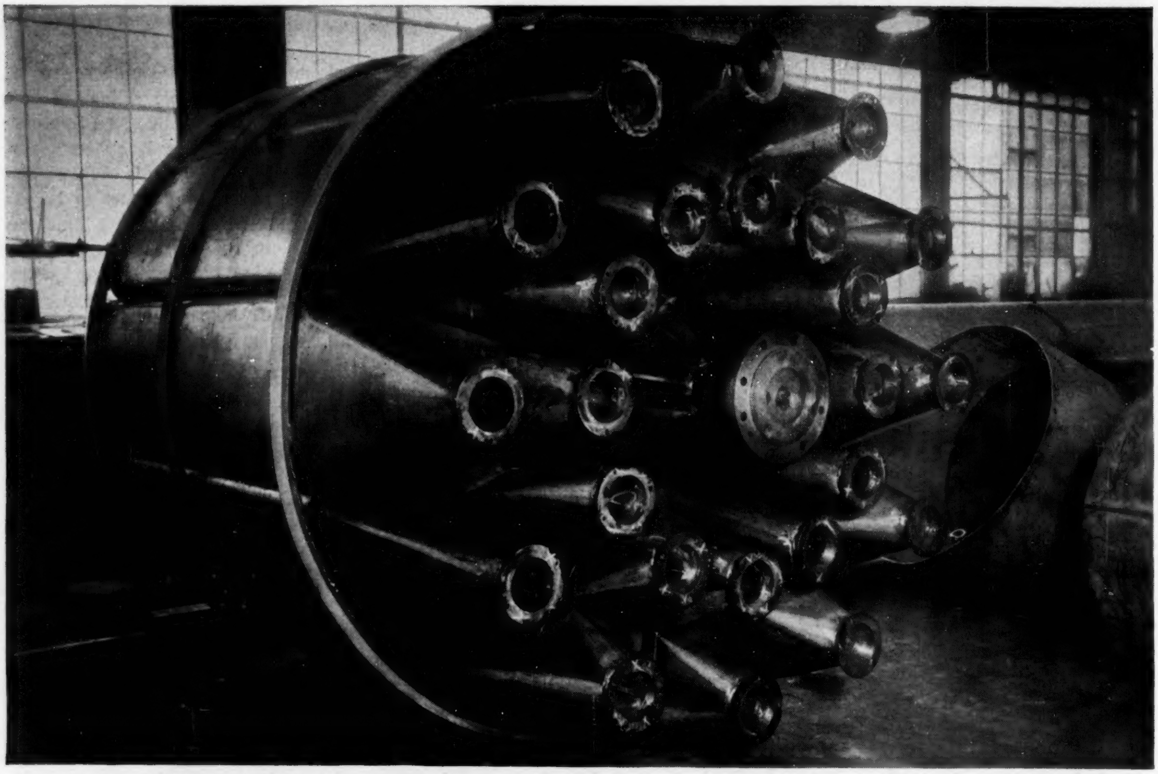
- Adoption of consultation facilities to make FTC's own accounting staff available to businessmen charged with price discrimination.
- Appointment of an accounting advisor to advise FTC members on accounting problems under Robinson-Patman, and to write special opinions interpreting the cost justification section of the law for the guidance of business.
- Use of pretrial techniques in FTC price discrimination cases to let the businessman know exactly what he must prove.

Charging competing customers different prices for the same goods is illegal, except when the price differences "make only due allowance for differences in the cost of manufacture, sale or delivery resulting from the differing methods or quantities in which such commodities are . . . sold or delivered."

But FTC has been so tough on cost justification defenses that only twice has a firm used it successfully and completely against an FTC charge of price discrimination.

No Cook Book. The new report has no clear-cut rules or methods for showing how you prove manufacturing and distribution costs. In fact, the committee, headed by Michigan

TAGGART: Urges more liberal view on cost defense justification.



Hot magnesium-carbonate slurry presents no corrosion problem when handled by the unit shown here. Made of chromium-nickel stainless steel throughout, this 24-duct indexing hopper for a manufacturer of pipe insulation is an example of all stainless process equipment fabricated by Stainless Products, Inc., Jersey City, N. J.

Chromium-nickel stainless frees hopper from trouble facing many process units

ONE HAZARD that operators face every day is *corrosion.*

As in other processing units, corrosion of an indexing hopper endangers product purity, inflicts expense for maintenance or repair and stops output during the downtime.

But the hopper above, made entirely of chromium-nickel stainless, faces no such trouble. Because ability to thwart attacks by a wide variety of corrosives is a basic characteristic of austenitic chromium-nickel stainless steels.

Helps in other ways, too

In addition, the high mechanical properties of stainless steels allow designers to cut bulk and deadweight without sacrificing strength or safety of process equipment.

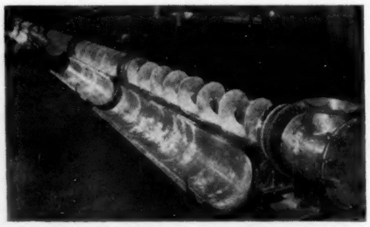
Fortified with Nickel, these steels withstand impact and battering, abrasion and erosion. They resist creep and oxidation at elevated temperatures, and retain high strength, toughness and freedom from "notch" effects, to below –400°F.

Easy to clean and keep clean, chromium-nickel stainless steels are sanitary metals that minimize maintenance.

Readily fabricated

Fabricators draw, spin, forge and solder stainless. They punch, shear, bend and weld this versatile material. Leading steel companies produce austenitic chromium-nickel stainless steels in all commercial forms. So investigate use of stainless steel equipment.

Whenever your difficulty is due to metal failure, send us the details. We'll give you suggestions on how to dispose of it. Write for List "A" of available publications. It contains a simple form that makes it easy for you to outline your problem. Send for it now.



Conveying abrasive phenolic powder calls for high resistance to wear. That's why stainless steel is used for this Archimedes conveyor, 50′ long and 14″ in diameter. Screw and housing tube, welded together, rotate as a unit. Design allows easier, faster cleaning, no matter what the color of resin handled. Fabricated by Stainless Products, Inc.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N. Y.

University's Herbert Taggart, warns that any attempt to lay down detailed procedures would be self-defeating and impractical. And the committee's strongest warning to FTC is to "stay away" from specific rules of accounting analysis under the R-P Act. Reason: cost accounting contains factors of judgment, is not an exact science.

On this basis, the report recommends that FTC should accept any cost justification study made in good faith and in accordance with acceptable accounting doctrines. Additionally, it advises that a well-designed system of expense classification suitable for cost control and the routine recording of expense data and statistical information furnishes the best foundation for answering any FTC questions as to whether cost differences justify price differentials.

FTC has made clear that it has taken no action on any recommendations, and that it is only now closely examining the report.

But many observers believe that, by and large, no formal announcement will be made if any of the policy recommendations are adopted; most of these can be worked into future FTC decisions without other formal action.

Get Them Back or Pay

Starting next Monday, slow-poke handling of your freight cars will become an even costlier luxury.

The Interstate Commerce Commission has slapped a new order (with stiff fines) on handling of freight cars by shippers and carriers. Effective April 9, the order is designed to speed up turn-around of freight cars, strikes at such practices as increasing the time in transit of loaded cars by holding them in yards and terminals, by sending them over routes other than the normal fast-freight routes—except in emergencies—or by backhauling them.

It is part of ICC's get-tough policy to ease the current freight car shortage. And, it is the first general order issued by ICC on the matter; other orders have been confined to specific areas or situations.

Violators of the new order—both shippers and carriers—will be brought into court. Maximum penalty is $500 for each violation.

Cutoff date for ICC's new order is Dec. 31, '56, providing the freight car shortage is eased by then.

DATA DIGEST

• **Chemical transportation:** 170-p. book covers truck transportation of all types of chemicals and compressed gases. Book is transcript of classes held last summer by the Manufacturing Chemists' Assn. and National Tank Truck Carriers, Inc. Price: $10; NTTC (Washington, D. C.).

• **Ethers and oxides:** 64-p. brochure supplies data on physical properties (with 34 charts), shipping, specifications, analytical methods, and constant boiling mixtures, and suggests applications. Carbide and Carbon Chemicals Co. (New York).

• **Ultraviolet light absorbers:** 20-p. booklet describes absorption characteristics, solubility data, plastic compatibility, color, plastic stabilization, and applications for old and new Uvinols. Antara Chemicals (New York).

• **Polyethylene waxes:** Brochure gives physical properties, compatibilities, suggested formulations, and scope of application of "E" (emulsifiable) and "N" (nonemulsifiable) Epolene polyethylene waxes. Eastman Chemical Co. (Kingsport, Tenn.).

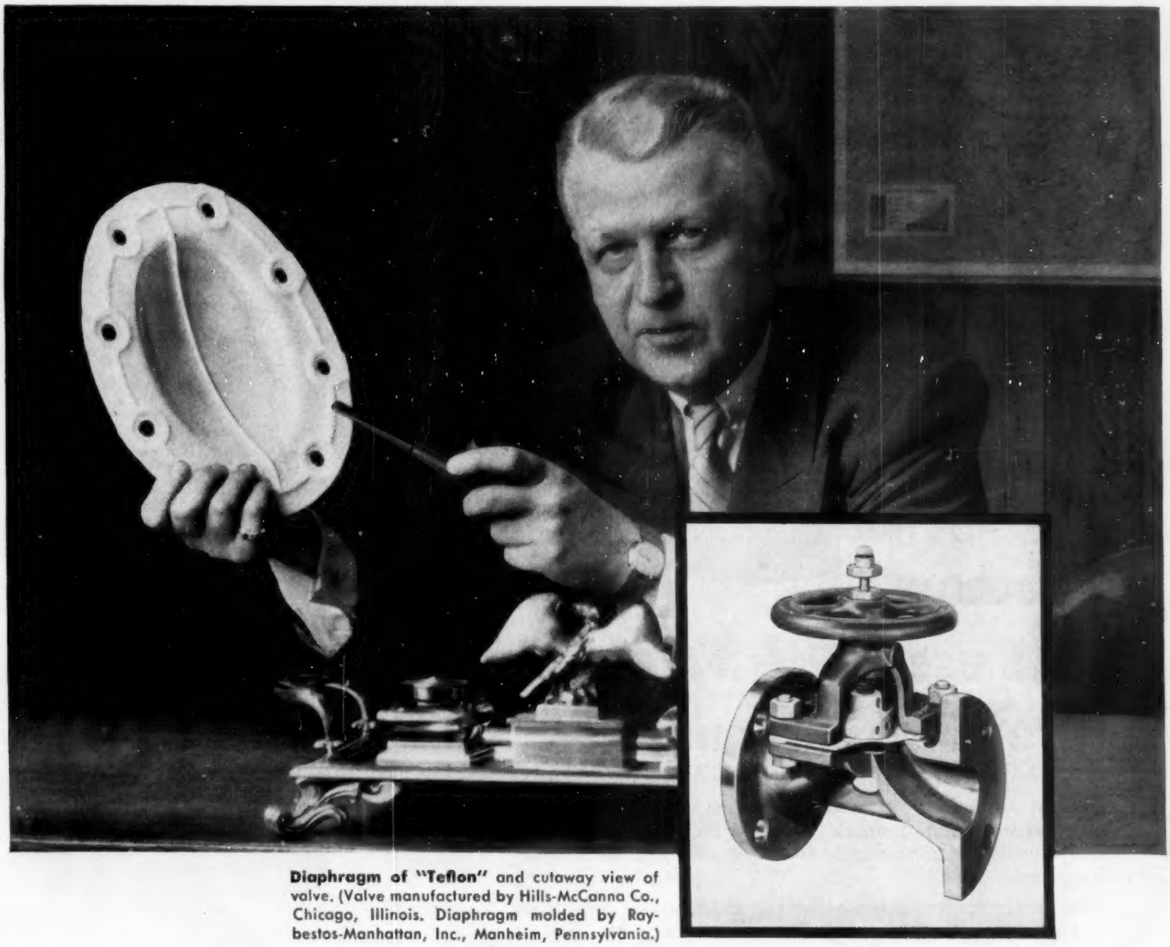
• **Aromatic "scent" chemicals:** New pocket-size edition of catalog furnishes product description, chemical and physical properties, price, shipping, specification, and application data on materials used in scenting. Dow Chemical Co. (Midland, Mich.).

• **Secondary plasticizer:** Bulletin describes chemical and physical properties of HB-40, high boiling mixture of partially hydrogenated terphenyls. Applications are suggested as an extender-type plasticizer for vinyls, styrene, ethyl cellulose, carbazole, and asphaltic substances. Monsanto Chemical Co. (St. Louis).

• **Statistical summary:** First supplement to fourth edition of the Chemical Statistics Handbook. Price: 60¢; Manufacturing Chemists' Assn. (Washington, D. C.).

• **Sodium:** 144-p. book critically reviews the physical and thermodynamic properties of sodium on best data available in early '55. Ethyl Corp. Research Laboratories (Detroit).

• **Rubber compounding:** brochure supplies physical and chemical data, and formulas for compounding insulation for wire and cable. Naugatuck Chemical Division of U. S. Rubber Co. (Naugatuck, Conn.).



Diaphragm of "Teflon" and cutaway view of valve. (Valve manufactured by Hills-McCanna Co., Chicago, Illinois. Diaphragm molded by Raybestos-Manhattan, Inc., Manheim, Pennsylvania.)

CW Report

The Sky's No Limit

Missiles are now a $1-billion/year business, could reach $2-billion/year by 1959.

The chemical industry takes almost 25% of missile spending. But there is still a big gap between what it is doing in this field and what it could do.

On the following 13 pages is as much as may be told about the industry's present role in the guided missile program the opportunities that lie ahead.

by Alan R. Mendenhall, Jr. and William Mitchell

C W Report

"SIX, FIVE, FOUR, THREE, TWO, ONE, FIRE!"

For an instant, the slender metal column seems to stand on its tail of fire; then it starts to rise, and in a trice, it's out of sight. Cameras, telescopes and electronic gear track the finned needle as it arches upward at supersonic speed. At 100 miles, it noses over for the long plunge. Plummeting back to earth at phenomenal speed, the missile's skin reaches red heat, glows briefly before final impact. Total elapsed time: 500 seconds. Period under power: 200 seconds. Fuel consumption: 40,000 lbs. of high-grade chemicals. That figures — for the brief air-borne life of the missile — to a thumping . . .

12,000-lbs./minute Chemical Market

Twenty years ago there was no missiles business. There was no need for one. But during World War II, the need developed—for the Germans, at any rate. Result: the inaccurate but deadly pulsejet V-1 ("buzz bombs") and rocket V-2 series of missiles and the rocket ME-163 fighter planes. After the war, the German missiles brain trust was split into small groups that were snatched up by the United States and the Soviet Union. Both are now racing for missiles supremacy. Goal: the ICBM, a 5,000-mile intercontinental ballistic missile with a thermonuclear warhead.

Spurred by the realization that there can be no reward for second place in this race, the U.S. has already invested an estimated $5 billion in the "birds." But many top officials believe that we are not spending fast enough. They want to put the program on a wartime emergency basis. Others believe that we are now advancing as fast as our industry and brain power allow.

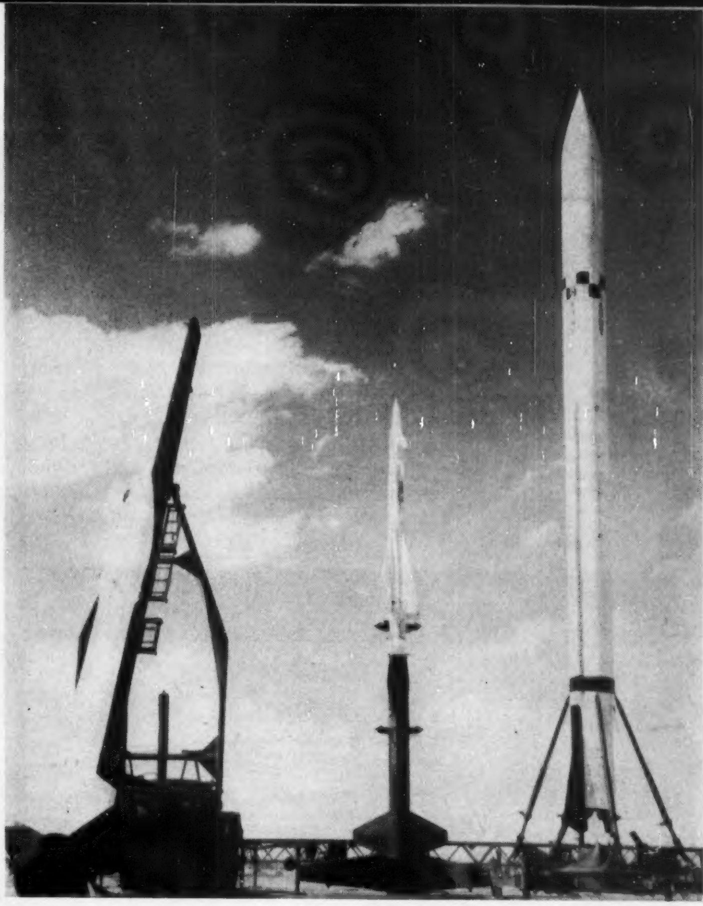
The point is debatable, as the news out of Washington plainly proves. But this much is certain: missiles are already big business and destined to get even bigger. The question is whether it will be by small steps or giant strides.

This year, the government will spend an estimated $917 million on guided missiles procurement, plus $250 million on missiles research and development (*see table: Missiles Budget*). In fiscal 1957, missiles procurement will rise to $1.3 billion—one-third more than the amount for fiscal 1956, almost double the figure for

MISSILES BUDGET: (in million dollars, estimated)

How it's spent	1955	1956	1957
TOTAL	891	1171	1526
PROCUREMENT	660	917	1276
RESEARCH & DEVELOPMENT	231	254	250
Procurement			
AIR FORCE	339	485	799
ARMY	—	260	300
NAVY	—	172	177
Research & Development			
AIR FORCE	—	—	100
ARMY	—	—	75
NAVY	—	—	75

Standing ready are these three big operational 'guns' of the Army. They are (left to right) the Honest John, Nike and Corporal.



fiscal 1955—while research and development is ticketed for another $250 million.

Of the total for 1957, the chemical process industry will get an estimated $220 million—slightly more than its '56 budget. Roughly, this is how the figure breaks down:

- $30 million for procurement of propellents.
- $40 million for research and development of propellents.
- $50 million for procurement, research and development of lubricants, hydraulic fluids, sealants, plastics and refractory coatings.
- $100 million for procurement, research and development of nonferrous metals and alloys.

This makes the missiles industry one of the top chemical markets in the U.S. And in the background is the market's hair-triggered potential for expansion.

Should the cold war turn hot, procurement would skyrocket,* of course. Demand for propellents, particularly, would hit an unimaginable high. Most missiles coming off production lines today end up in stockpile reserves, except for a small percentage used for test purposes, and an even smaller percentage used for operational purposes (e.g., rocket assists used on take-offs).

But growth of the chemical industry's stake in guided missiles does not depend on world tensions alone. A great deal rests on the industry itself, and how successfully it is able to meet the exacting demands of missile builders.

In the case of propellents, for example, the demand is for combinations of fuels and oxidizers to enable missile men to put more energy into smaller packages. What these propel-

*Unlike aircraft, most missiles are not operational units. Not re-usable, they're more like bullets—once they're "shot," they're done with.

New 'Birds' Poised for Flight

The propeller-driven military airplane is drawing its last breath. It has gone as high (45,000 ft.) and as fast (600 mph.) as aeronautical engineers can push it. Reciprocating engines simply cannot gasp enough air to function at the rarefied heights now demanded of military aircraft.

What is needed is another concept of flight and a new technology to put this concept on an operational basis. This challenge is successfully being met. In the last 10 years, engines have been developed that are not limited by the density and oxygen concentration of their environment.

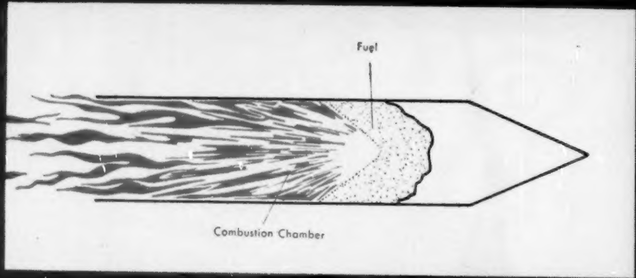
These engines have carried airplanes through and well beyond the sound barrier. But even so, conventional airframes can't go much faster than 2,000 mph.; for one thing, their wings create too much drag. By removing the wings, substituting stabilizer fins, sharpening the nose, slimming the over-all silhouette, engineers have more than doubled the potential for speed.

The question now is whether the pilot can survive at speeds and altitudes never before approximated. There is still no final answer, which is one compelling reason for electronic guidance of the craft—hence the guided missile.

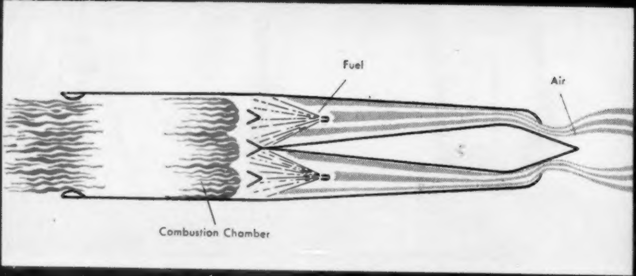
Higher and Faster: Missiles have already reached (announced) speeds of about 5,000 mph. and altitudes of 250 miles. But models capable of tripling these records are already on the drawing boards.

It seems certain that rocket engines and nuclear propulsion will eventually replace the ramjets and turbojets, which now propel most missiles. The ultimate ceiling of the rocket engine is limited only by the amount of propellent the missile can carry; and speed is limited only

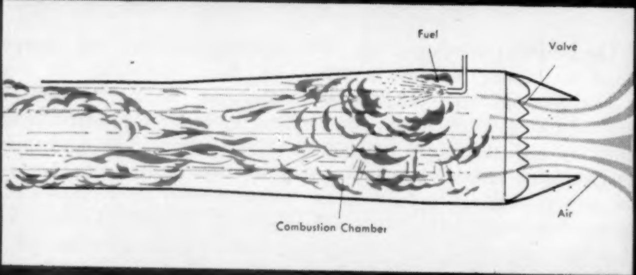
Check-out on Jets.



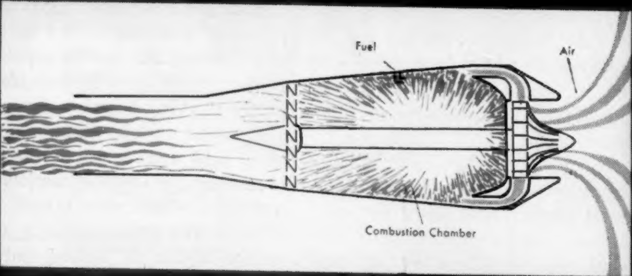
Rocket



Ramjet



Pulsejet



Turbojet

Chemical Man's Primer of Jet Propulsion

All guided missiles are jet-propelled. But jet engines vary widely in design.

• **Rockets,** unlike other jets, carry their own oxidizer supply, thus are not limited by the need for air. The rocket is the only jet engine that is closed at one end. In its simplest form—the solid-propellent engine—it works like this: the propellent is loaded directly into the firing chamber and ignited; combustion gases rush out through the rear, open end of the firing chamber, thrust the missile forward at speeds up to thousands of miles per hour.

• **Ramjets** have no moving parts and only three major components: diffuser, combustion chamber and nozzle. Air (the oxidizer) enters the diffuser and is compressed by the ramming action of the forward movement. Fuel from storage tanks mixes with the air, is ignited in the combustion chamber. The ramjet needs a push (rocket assist, etc.) to get started, can make up to 3,000 mph.

• **Pulsejets** are intermittent-firing jet engines that have a maximum speed of 700 mph. Like the ramjet, the pulsejet requires an initial push. Valves in its nose close after the fuel and air mixture is ignited, thereby allow only a rear exit for gases.

• **Turbojets** are rotating engines with a potential speed of 1,500 mph. They carry compressors, powered by escaping combustion gases, need no push to get going. By extending the shaft of the turbine that turns the compressors, and attaching a propeller to it, the turbojet is converted into a turbo-prop engine. Both have wide potential civilian use, limited military.

Story continued from p. 63

lents save on hardware (fuel tanks, storage tanks, etc.) could be used to pay for additional fuel procurement and research.

Propellents, of course, are only a small part of the picture. Today, the call is out for a broad array of other products—lubricants, sealants, metals and alloys; for research—much of it basic—on the combustion chamber (missile motors), and many other problems.

More significant, perhaps, than the chemical process industry's ability to fill the difficult demands of the missile makers is its puzzling reluctance to do so.

Despite the size of the potential rewards, most chemical companies have shied away from the missiles field. In the light of their usual aggressiveness in going after new markets, their hesitancy proves particularly perplexing.

There are, of course, some obvious deterrents to selling the missiles industry: the shroud of secrecy surrounding all operations, uncertainty concerning the size of markets, the high ratio (at least, initially) of research to sales. But they don't fully explain the chemical industry's reluctance to seek out missiles markets. More than likely, it's a case of the industry's being unable to determine where it could fit into the picture.

Fortunately, this trend is reversing itself. More and more chemical and allied firms are moving into the missiles field. (For a sampling of current participants, see box, *Who's Making Chemicals for the Missiles Program.*)

How to Break In

Actually getting into the program is another story. Although the various branches of the government recently streamlined their contract and purchasing operations, the hows and wherefores of participation are still likely to be confusing to the neophyte.

Standard practice in regard to missiles is to let a systems contract to a prime contractor. He then becomes responsible for supplying the finished bird, plus: vehicles for servicing and transportation, simulators for training, panel displays for education, fire control points, radar and telemetry

Story continued from p. 63

by the power that chemists can build into the propellent.

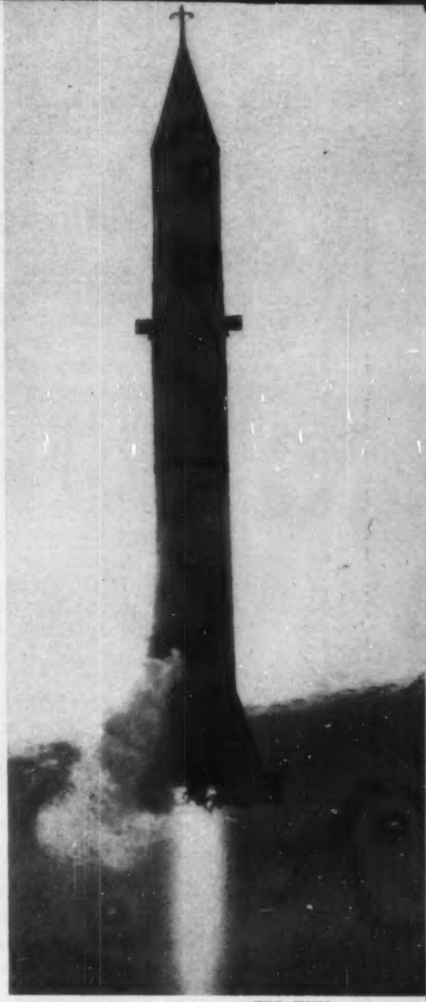
War Birds: Most missile men refer to their offspring as birds, although missiles take their names from birds, animals, mythical gods, warriors, and Indian tribes. Today, six missiles are in operational use: Corporal, Honest John, Nike, Terrier, Sparrow and Matador. In concept, these date back to 1946.

Replacements for these operational missiles are well along. Recent unveiling of developmental missiles such as the Falcon and Talos spotlights the tremendous conceptual advances already attained. These newer missiles, moreover, are only interim models that can serve as military weapons if need be; they are more important as prototypes for missiles of the future.

Missile Geneology: Each of the armed forces has its own group of missiles.

All missiles eventually going to the Army, for example, are considered as one family, regardless of purpose. But the Army regards missiles as an extension of artillery, accordingly classifies them either as surface-to-surface missiles (field artillery) or as surface-to-air missiles (anti-aircraft).

The Air Force, thinking in terms of conventional functions, divides



WIDE WORLD

GOING UP: The intermediate-range Redstone guided missile is the latest addition to the Army family.

WIDE WORLD

SNARK is a low-speed, low-altitude, intercontinental missile.

Who's Making Chemicals for the Missiles Program

Aerojet-General Corp. is one of the largest companies devoted to research, production, and development of rocket motors, components, and propellents. It makes both liquid and solid propellent engines, uses most of its propellent output in research, sells the rest to other missile firms.

Aluminum Co. of America sells nonferrous metals and alloys to the rocket industry.

Becco Chemical Co. (division of FMC) is a major supplier of 76%, 90% and 100% hydrogen peroxide to the rocket industry.

Bram Chemical Co. occasionally supplies nonferrous metals and alloys as well as powdered metals to the missiles program, expects the demand for these materials to go up in the near future.

Commercial Solvents Corp. sees the missiles field as a potential consumer of nitroparaffins and nitroparaffin derivatives. The company is conducting research on solid propellents, selling small amounts of ethyl alcohol, methyl alcohol, nitromethane, ammonium nitrate, and unsymmetrical dimethylhydrazine to this field.

Esso Standard Oil Co. and affiliate Penola Oil Co. market limited quantities of jet fuels and lubricants to the rocket industry. Another affiliate, Enjay Co., Inc., markets isopropyl alcohol.

Ethyl Corp. manufactures n-propyl nitrate for use as a monopropellent for missiles. An offshoot of its amyl nitrate (a diesel ignition improver) production, this accounts for almost 1% of sales.

Fairmount Chemical Co. has been producing hydrazine since the early '40s, but considers its future as a rocket propellent uncertain.

G. Frederick Smith Chemical Co. is concerned mostly with propellent research and development, also makes special analytical reagents for the field. The firm is studying the effect of trace amounts of different materials in rocket propellents.

Hercules Powder Co., through its explosives department, is contributing to the development and production of rockets and guided missiles. Most of this work is carried out at Radford Arsenal, Sunflower Ordnance Works, and Allegany Ballistics Laboratory.

Houghton Laboratories, Inc., got into the missiles field with an established product (a special-purpose sealant) that filled a particular need. Sealant sales to the rocket industry constitute about 1% of total company sales.

Kaiser Aluminum & Chemical Sales, Inc., sells aluminum to both aircraft and missile firms, is unable to determine amount sold specifically for rocket production.

Metalectro Corp., supplier of unsymmetrical dimethylhydrazine, was just taken over by National Distillers. Metalectro's continued production of UDMH is uncertain.

Olin Mathieson Chemical Corp. is currently supplying liquid anhydrous ammonia, unsymmetrical dimethylhydrazine, methyl alcohol, hydrazine, ethylene oxide, double-base solid propellents and nonferrous metals and alloys to the rocket industry. The company is also carrying out research and development on advanced missile fuels, through its tie-in with Reaction Motors and Marquardt Aircraft.

Phillips Petroleum Co., at company-operated Air Force Plant No. 66, recently placed in operation a plant for development and manufacturing control of solid rocket propellents.

Products Research Co., which has long served the aircraft industries, is currently supplying electrical potting sealants for missiles.

The Quaker Oats Co. is supplying special-grade furfural alcohol.

Reaction Motors, Inc., a pioneer in the development and production of liquid propellent rocket engines, in recent years has become increasingly active in development of solid propellents.

Reynolds Metals Co. supplies nonferrous metals and alloys, powdered metals, and ceramics, as well as finished containers and pipes, to the rocket industry. In addition, the company is carrying out research related to missiles operations.

Rohm & Haas Co. operates chemical laboratories concerned with basic rocket research at Redstone Arsenal.

Shell Chemical Corp. supplies ammonia and ethyl alcohol to the missiles industry.

Socony Mobil Oil Co., Inc., supplies no raw materials, does sell standard fuels and lubricants.

Standard Oil Co. of California markets J-P fuels and lubricants, part of which is believed to end up in the missiles program.

Standard Oil Co. of Indiana recently put into operation a special laboratory for research and development work on solid propellents.

Thiokol Chemical Corp. is doing solid propellent research and development at Redstone Arsenal and at Elkton, Md., and has sizable propellent production units at Longhorn Ordnance Works.

Western Electrochemical Co. (division of American Potash & Chemical) recently expanded its facilities for production of perchlorates, which are used chiefly in JATO rocket units.

Westvaco Chlor-Alkali (division of FMC) produces unsymmetrical dimethylhydrazine, expects that its role in the missiles field will grow.

Other missiles program participants include: Atlantic Research, Du Pont, Atlantic Refining, Wyandotte, Union Oil Co. of California, Stauffer Chemicals, Jefferson Chemical, Minnesota Mining & Manufacturing, Norton Co., Union Carbide and Carbon, and Allied Chemical & Dye. A number of chemical companies, involved in one aspect or another of this program, are not aware of their involvement because of the indirect nature of their tie-in.

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stations, test facilities, etc.

In actual practice, production of the missile itself is often divided into components such as propulsions systems (this may include selection and procurement of propellents), guidance, airframes, launchers, etc.—most of which are then subcontracted. The firm responsible for the propulsion system, if not a propellent producer, will then most likely go to a chemical company to subcontract for the propellent or buy it outright.

Thus, most chemical process companies will enter the missiles program on a subcontract (except where research and development work is involved). The best way for neophytes to learn more about participation is to go to a prime contractor or a subcontractor already in the field. The government, of course, will furnish the same information.

The potential reward, however, can more than compensate for the effort.

What's Needed

Propellents—Here lies the most rewarding opportunity for chemical development in the missiles field. The dream of missile men is rocket-powered, passenger-carrying missiles. Their nightmare is all-out war. In either case, the demand for propellents could easily expand 10-fold, or more.

At present, however, the need is for more research. Despite the tremendous amount of research and development that has been done, there is no material available that will satisfy even half of the requirements of the "ideal" liquid propellent (*see box, The Ideal Liquid Propellent Passes 13 Tests*).

Almost all oxygen-deficient organic chemicals have been tried as fuels. These include such organics as amines, alcohols, aliphatic and aromatic hydrocarbons and such inorganics as liquid hydrogen, ammonia, hydrazine, and low-molecular-weight metals. Liquid oxygen, ozone, nitric acid, nitrogen tetroxide, nitric oxide, fluorine, oxygen difluoride are among hundreds of materials that have been evaluated as oxidizers.

Out of the resultant welter of combinations, the few that have shown promise were passed on to the missile engineers, who narrowed the field even further. They found some that work,

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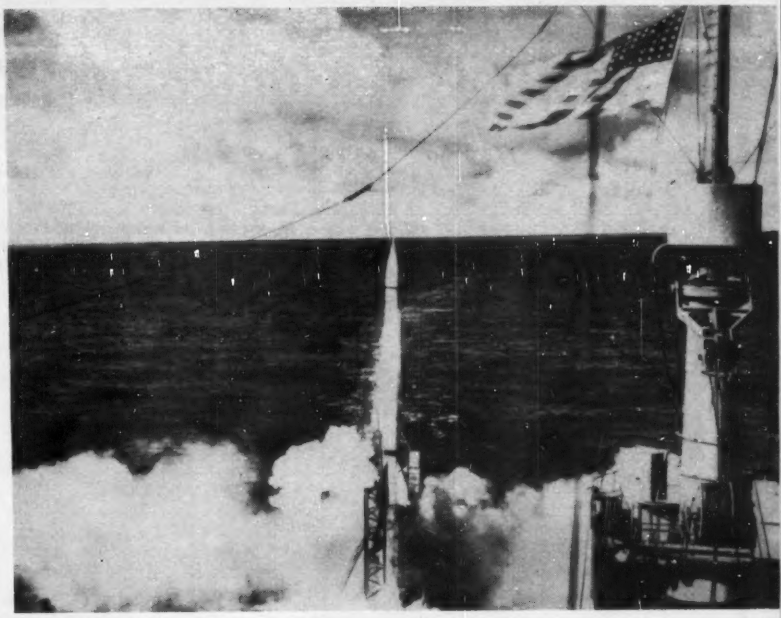


NAVY VIKING, rocket-powered, is high-altitude research missile.

its family into air-to-air missiles (fighters), air-to-surface missiles (bombers), and target missiles. Extending its thinking somewhat, the Air Force has further gathered under its domain surface-to-surface missiles such as the Matador (bombers), surface-to-air missiles such as the Bomarc (interceptors), and research missiles such as the Aerobee (high-altitude research).

The Navy family of missiles includes vehicles in all of these categories. Among other Navy missiles, for example, there are the Regulus (surface-to-surface), Terrier (surface-to-air), Sparrow (air-to-air), Bullpup (air-to-surface), Pogo (target), and the Viking (high-altitude research). In addition, the Navy now has one type of vehicle all its own, the air-to-underwater missile (Dove and Petrel).

Honorable Ancestry: Like many weapons, rockets and guided missiles can trace their origins back to the Chinese. The basic principle in rocketry—reaction—was known more than 2,300 years ago when the first use of ceremonial rockets was noted.

Continued on p. 70

FINNED FALCON is Air Force missile—smallest in production.

Missiles: A Guidebook for the Chemical Pro

CLASS		SURFACE-TO-SURFACE[1]										SURFACE-TO-AIR					
Function		Offensive weapons designed to deliver conventional, atomic or thermonuclear warheads over distances ranging from a few miles to 5,000 miles. (These vehicles make up the major part of the U. S. guided missiles program.)										Primarily defensive weapons for use against aircraft and other missiles. (These vehicles constitute the second most important group of guided missiles.)					
General Data	**Name**	Corporal	Hermes	Honest John	ICBM (Atlas)	Lacrosse	Matador	Navaho	Redstone	Regulus	Snark	Bomarc	Hawk	Loki	Nike-I	Talos	Ter ier
	Designation	XSSM-A-17			SM-65		TM-61	SM-64		XSSM-N-8	SM-62	IM-99			XSAM-A-7	XSAM-N-6	XSAM-N-7
	Service	Army	Army	Army	USAF	Army, USMC	USAF	USAF	Army	Navy	USAF	USAF	Army	Army	Army	Navy	Navy
	Status	P, O		P, O	R, D	P	D, P, O	R, D	R, D	P	D, P	R, D		P	D, P, O	D, P	P, O
	Contractor	Firestone	GE	Douglas	R-W		Martin	NAA	Chrysler	CV	Northrup	Boeing	Ray.	ECA	Douglas	Bendix	Convair
Physical Data	**Length less booster**	40′	25.8′	27′	>100′					33′	60′						14′
	Wing (fin) span		8.2′	8′						21′	40′						
	Body diameter	2.5′	2.8′	2.5′						4.5′	4.5′			3″			1′
	Take-off weight	12,000 lbs.	6,600 lbs.	6,000 lbs.	>100 tons					14,500 lbs.		5,000 lbs.					3,300 lbs.
Power Plant	**Type**	lpr	lpr	spr	lpr	spr	tj	rj	lpr	tj	tj	2 rj		spr	lpr	rj	spr
	Manufacturer	Ryan	GE	Herc	NAA, Aero		All	CW	NAA	All	P&W	Mar		GC	Aero, Bell	MD	ABL
	Fuel	aniline	eth				JF	JF		JF	JF	JF				JF	
	Oxidizer	nitric acid	lox				AA	AA		AA	AA	AA				AA	
Launcher or Booster	**Type**	none	none	none			spr	lpr	none	2 spr	sl	lpr		none	spr	spr	spr
	Manufacturer							NAA		Aero		Aero			ABL		ABL
	Remarks						mobile launcher			launched by subs	solid propellent						
Performance	**Speed**		Mach 2.5		>Mach 22.0		Mach 0.9	Mach 3			Mach 0.9	Mach 2.5			Mach 2		Mach 2.5
	Altitude		15 mi.		>500 mi.			13 mi.			8.5 mi.						12 mi.
	Range	50 mi.	30 mi.	15-20 mi.	5,000 mi.	8-10 mi.	600 mi.	IC	200 mi.		IC	250 mi.			20-25 mi.		20 mi.
Guidance	**Type**			unguided				st			st, ie			unguided			br
	Manufacturer	Gil, M	GE		GE, Arma			NAA							WE	F	Reeves
Remarks					ec $1 mil. without warhead		ec $90,000					Boeing considering Salt Lake City or Denver as production site for Bomarc			May use plastic booster cases		

*Chemical Week editors compiled this table from unclassified information.

[1]Also in this class are the following missiles about which little has been revealed: Sergeant, a solid propellent missile under development at JPL, is considered in the Corporal class with respect to range and is a big brother to Honest John; Little John, a smaller version of Honest John but with a longer range; RV-A-10, a GE spr missile said to be world's largest; Goose, a long-range missile to be developed by Fairchild under USAF sponsorship; Titan, a long-range missile in the Atlas class; and Thor, a 1,500-mile mid-range missile.

LEGEND:

- **AA** —ambient air
- **ABL** —Alleghany Ballistics Lab.
- **Aero** —Aerojet-General
- **All** —Allison
- **Bell** —Bell Aircraft
- **br** —beam riding
- **Con** —Continental Motors
- **CV** —Chance Vought
- **C-W** —Curtiss-Wright
- **D** —development
- **ec** —estimated cost
- **ECA** —East Coast Aeronautical
- **EK** —Eastman Kodak
- **eth** —ethanol
- **F** —Farnsworth
- **Fair** —Fairchild Engine & Airplane
- **GC** —Grand Central Aircraft
- **GE** —General Electric
- **Gil** —Gilfillian
- **Herc** —Hercules Powder
- **IC** —Intercontinental
- **ie** —inertial
- **JF** —jet fuel
- **JPL** —Jet Propulsion Lab., Cal. Tech.
- **lox** —liquid oxygen
- **lpr** —liquid propellent rocket
- **M** —Motorola
- **Mar** —Marquardt Aircraft
- **McC** —McCulloch Motors
- **MD** —McDonnell Aircraft
- **na** —nitric acid
- **NAA** —North American Aviation
- **NRL** —Naval Research Lab.

Story begins on p. 61, continued on p. 70.

ess Industry*

Here in brief is the U.S. guided missiles program—the important missiles, the manufacturers, a list of opportunities for the CPI.

AIR-TO-AIR: Aircraft armament against enemy aircraft or missiles.			AIR-TO-SURFACE: Close support of ground troops, long-range bombs, and submarine killers.					TARGET MISSILES		RESEARCH MISSILES		
alcon	Sidewinder	Sparrow	Bullpup	Dove	Lazy Dog	Petrel	Rascal	Firebee	Pogo	Aerobee	Vanguard	Viking
AR-98	XAAM-N-7	XAAM-N-2, 3, 4	XASM-N-7	XASM-N-4		XAUM-N-2	GAM-63	Q-2				RTV-N-12a
SAF	Navy	Navy	Navy	Navy	USAF	Navy	USAF	USAF	Navy	USAF	Navy	Navy
, P	D, P	D, P, O	R, D	P		P	D, P	P, O	D	P, O	R, D	P, O
ughes	Philco	Douglas	Martin	EK	Eglin AFB	Fair	Bell	Ryan		Aero	NRL	Martin
			11′				20′	17.2′	14′	20′		42-49′
								11.2′			no fins	9-13′
			1′				4.5′			1.3′		3′
12 lbs.								1,848 lbs.				
r	3 spr	spr	spr			tj	3 lpr	tj	spr	lpr	1st-stage lpr	lpr
hiokol		Aero				Fair	Bell	Fair, Con		Aero	GE	RMI
						JF		JF			gas, eth	eth
						AA		AA			lox	lox
one			none	one		none	none	1 spr	spr	spr	2nd-stage lpr	none
								Aero		Aero	Aero	
											udmh fuel, na oxidizer	
						Mach 0.7	Mach 2	Mach 0.9			Mach 25	Mach 5.7
w								8 mi.		68 mi.	200-800 mi.	158 mi.
mi.		5 mi.					100 mi.	750 mi.				
ughes												
roduction ·100/month; c $25-50,000; ventual ost, $10,-00	ec <$ 1,000	ec $10,000				Actually, an air-to-underwater missile		Also a tactical missile; 80-minute flight time; 100 gal. fuel	Extrem: altitude target	High-altitude research; ec $15 - 30,-000	3-stage satellite vehicle; 3rd stage is spr; minimum of 10 to be made	ec $200,-000 including servicing and launching

O —operational
P —production
pj —pulse jet
P&W —Pratt & Whitney Aircraft
R —research
RA —Redstone Arsenal
Ray —Raytheon
rj —ramjet
RMI —Reaction Motors
RW —Ramo-Wooldridge
sl —sled launcher
spr —solid propellent rocket
st —star tracking
tj —turbojet
USAF —United States Air Force
udmh —unsymmetrical dimethyl hydrazine
USMC —United States Marine Corp.
WE —Western Electric
Wr —Wright Aeronautical

√ Checklist of Opportunities

Structural Materials

Titanium alloys, cobalt-base alloys, magnesium alloys, copper and copper-base alloys, molybdenum, aluminum and aluminum alloys, nickel alloys; glass fiber-reinforced epoxy resins; polymethyl methacrylates, and most other plastics; zinc, chromium, silver, cadmium, nickel, and tin plating; aluminum and magnesium coatings; diamonds and sapphires.

Graphite, silicon carbide compounds, ceramic oxides, nickel molybdate, zirconium boride.

Propellents

Ammonia, aniline, alcohols, hydrazines, JP fuels, ethylene oxide, oxygen, hydrogen peroxide, mixed oxides of nitrogen, gasoline, nitric acid, n-propyl nitrate, acetylenes, polysulfide rubbers, unsaturated polyesters, Geon resins, butadiene vinyl pyridine polymers, potassium perchlorate, ammonium nitrate, ammonium perchlorate, plastics, nitrocellulose, nitroglycerine, methacrylates, kerosene.

Lubricants

Silicone-base oils, fluorocarbon oils, heterocyclic hydrocarbon oils, mineral oils.

Pressurants

Helium, nitrogen, air.

Control Elements

Germanium, selenium, ruthenium, silver, gold, zirconium, platinum, rhodium, iridium, palladium, indium, tantalum, tungsten.

Story continued from p. 67
but none that measure up to the ideal. Some components of workable propellents are: alcohols, ammonia, ethylene oxide, hydrazine compounds, hydrocarbon chemicals, hydrogen peroxide, nitric acid, oxygen and turpentine.

Many of the liquid propellents now available suffer from low density, poor storage life, toxicity and corrosiveness. At the same time, they are effective, cheap, readily available, and comparatively easy to control. Among those liquid-propellent ingredients now in widest use are liquid oxygen, ethanol, nitric acid, hydrocarbons, ammonia and hydrogen peroxide.

Compared with liquids, solid propellents offer certain advantages, particularly for smaller missiles.

The solid-propellent rocket system is much less complex than the corresponding liquid system. It requires no separate propellent storage tanks, so pumping and control devices are eliminated, and the engine needs no moving parts.

Too, solid propellents have high combustion efficiency, offer dependable—or, more important, predictable—performance, and are relatively insensitive to mechanical shock. On the other hand, combustion control is difficult, must be predetermined by geometrical design of the propellent charge. And, for now at least, solid propellents cost considerably more than liquids.

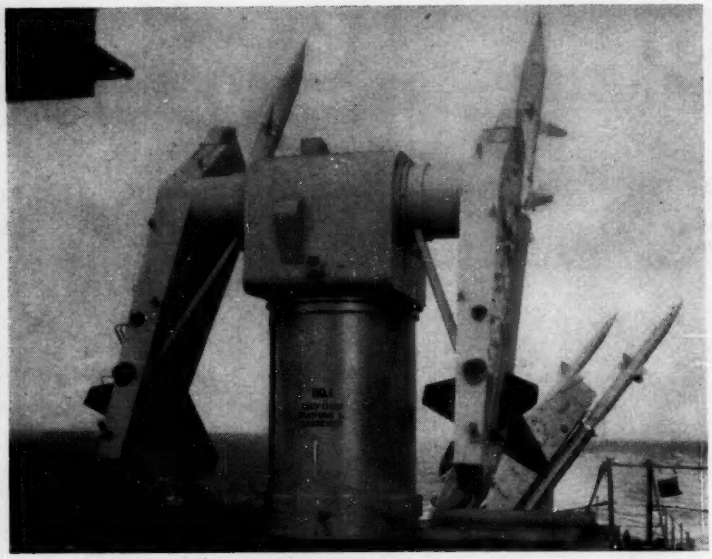
Other disadvantages include lack of flexibility and high thermal expansion coefficients, the latter leading to flow, creep and deformation of the propellent charge when it becomes hot.

What missile men are looking for is embodied in the box, *Five Key Characteristics of the Ideal Solid Propellent.*

A highly interesting line of solid propellent study deals with powdered metals. Most of this work is still classified, but it is believed that the metals under consideration are chiefly the light elements (because of their high energy release per unit weight), such energy release per unit weight), such nesium and their compounds.

One of the most visionary projects under way centers about the use of nuclear fuels to ionize and accelerate gases into high-velocity jet streams. Most of this work is being carried out at Goodyear Aircraft.

Story continued from p. 67



NAVY'S ROCKET-POWERED Terrier anti-aircraft missile.

Then, in 1232 A.D., embattled Chinese refined these crude ceremonial rockets, used them in battle to pot enemy Mongols in the siege of Kai-Fung-Fu. In the time since, rockets and missiles have come a long way.

During World War II, Germany peppered Britain with pulsejet V-1 missiles, and rocket V-2 missiles. U.S. forces fired 30,000 rockets in the capture of Okinawa, and in the Battle of the Bulge, one battalion of the U.S. 1st Army fired approximately 1,800 rockets in 18 minutes. By VJ Day, 1,200 American war plants were turning out $100 million worth of rockets a month.

Today, the U.S. and Russia are in a breakneck race for accurate, long-range missiles.

By 1965, the 5,000-mile intercontinental ballistic missile may well be operational.

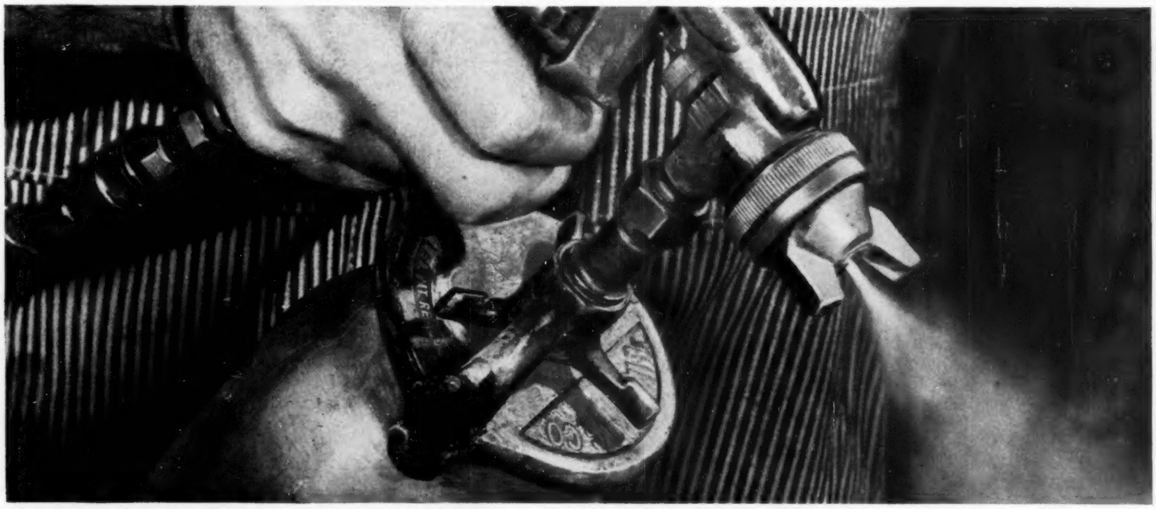
The ICBM, of course, is not the ultimate weapon. Rocket men are already talking about interceptor missiles that, given 20 seconds alert, can be armed, aimed and sent aloft in time to knock their intercontinental brothers out of the sky while still miles away from population or industrial centers.

For the Future: The mainstays of the present U.S. missiles program (*see chart: Missiles: A Guidebook for the Chemical Process Industry*) are mostly interim weapons. Even while they are poised on their launchers awaiting word of the approach of unfriendly aircraft, they are continually being refined. And at the same time, of course, completely new lines of missiles are being developed—the government is working on two new long-range missiles, the 1,500-mile Thor and the 5,000-mile Titan.

The fast pace of missiles development calls for flexibility on the part of companies operating in this area. For firms just getting into the program, it will mean many adjustments in the standard operating procedure. Most significant, perhaps, will be the need to meet specifications almost as soon as they are drawn.

To chemical process companies, missiles development presents both a challenge and an invitation. The problems that must be faced and solved seem almost limitless in number and complexity. Their solutions, moreover; often give rise to still more complicated problems. But the problems must be solved, and the chemical industries are in the best position to find many of the answers. The rewards for the right answers are commensurate with the effort invested in finding them.

THE START with your PAINT REMOVER



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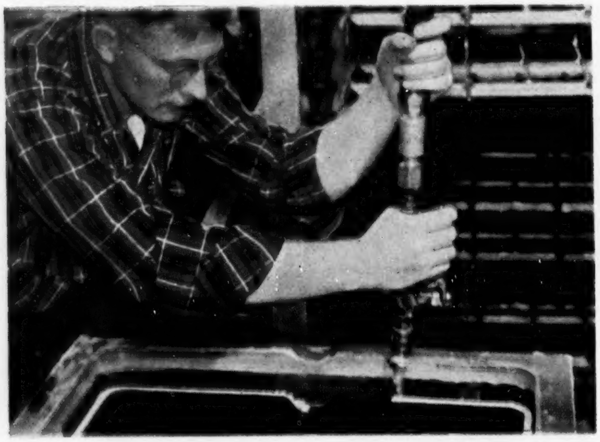
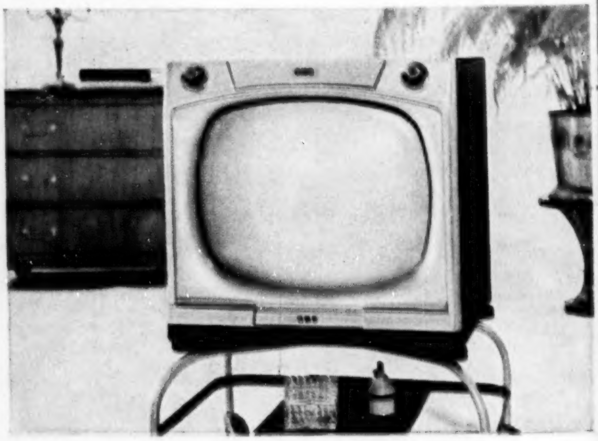
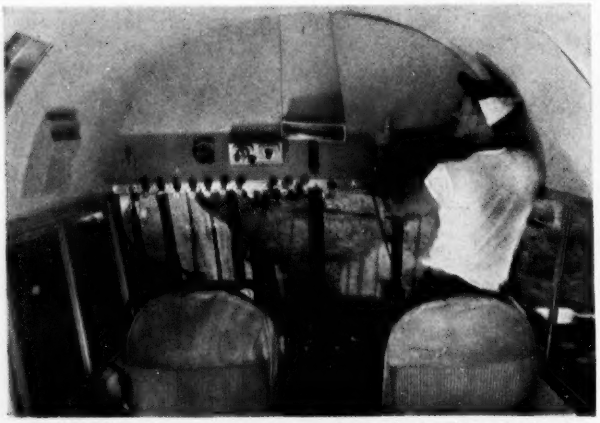


FINISHED BEFORE IT WAS FORMED, this beautiful television cabinet won't chip, crack or craze, defies abuse, abrasion and age. It's made of sheet PLIOVIC laminated to metal.



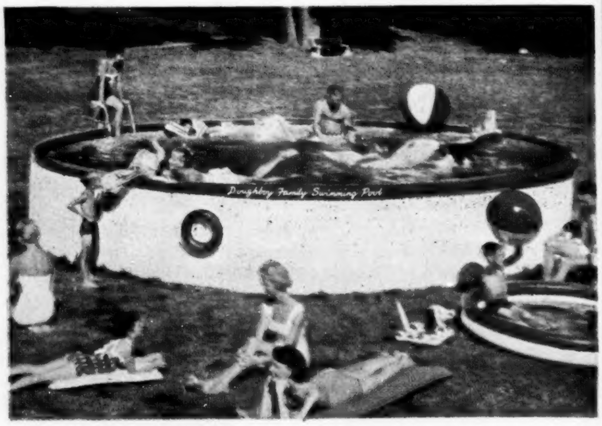
What do Flowable Gaskets, Flying



WALLS THAT FLY are these attractive panels of calendered PLIO-TUF for aircraft interiors. They are strong, light in weight and highly resistant to impact at low temperatures.

TRUE MEASURE OF QUALITY AND QUANTITY is offered by this pump with liquid end molded of impact- and chemical-resistant PLIO-TUF. Unique construction permits the accurate metering of the most corrosive liquids and slurries.

CRYSTAL-CLEAR SHOWCASES for soft goods are made from tough, transparent film of blown PLIOVIC. It is easily heat-sealed to form dust-free package—resists roughest handling.



KING-SIZED KIDDIE POOL lets whole family swim in backyard. It's made of heavy-duty PLIOVIC sheeting for high strength and resistance to water, sunlight, hard wear and age.

CW Report

The Ideal Liquid Propellent Passes 13 Tests

1 High energy (specific impulse, at least 350 seconds).
2 Boiling point greater than 90 C.
3 Freezing point below —60 C.
4 High viscosity index—i.e., only slight viscosity changes over wide temperature range.
5 Density greater than 0.9 grams/cubic centimeter.
6 No toxic effects.
7 Noncorrosiveness to standard materials of construction.
8 Low cost.
9 Ease of ignition with common oxidizers or fuels.
10 Insensitiveness to mechanical and thermal shock.
11 Low vapor pressure.
12 Suitability as a regenerative coolant.
13 Nonluminous exhaust products.

Liquid propellents are usually made up of two components—fuel and oxidizer—although monopropellents are known.

Researchers working with atomic accelerators have already created these high-velocity jet streams in the laboratory. But most missile men believe it will be a long time before the first ion-propelled space vehicle leaves the ground.

Old hat, by comparison, available solid propellents still do a creditable job of moving missiles through the air.

Solids are generally divided into two broad groups: double-based propellents, such as nitrocellulose and nitroglycerine, plasticized with methacrylates; and composite propellents comprising discrete particles of fuel and oxidizer in a heterogeneous system.

Ammonium nitrate, ammonium perchlorate, potassium nitrate, and potassium perchlorate (with available oxygen ranging from 20 to 46%) are the current choices for composite propellent oxidizers, while the favored fuels are unsaturated polyesters, polysulfide rubbers, butadiene-vinylpyridine polymers, and various other resins.

Today's propellents are good, but the need is for something better. Missile men are convinced the ideal propellents exist somewhere in the vast realm of chemical synthesis. It's up to the chemist to find them. If successful, such research will revolutionize the missiles industry.

Lubricants and Sealants—Demand for lubricants and sealants will be considerably less than that for propellents. But any lubricant or sealant accepted for missiles should find remunerative civilian applications as well (*CW, Sept. 17, '55, p. 64*).

The record of development in this area closely parallels that in the propellent field, especially where lubricant development is concerned. Up to 1940, major advances in both lubricants and propellents were based on petroleum refining improvements and empirical advances in the use of additives. More recently, researchers have placed increasing emphasis on synthesis.

Five Key Characteristics of the Ideal Solid Propellent

1 High tensile strength to prevent deformation under pressure and acceleration.
2 High percent elongation to counteract deformation under pressure.
3 Good adhesion so that charge can follow expansions and contractions of motor chamber without breaking the bond in bonded rocket motors.
4 High initial fluidity in the case of cast propellents to permit the propellent mixture to be poured into the rocket motor case.
5 Controllable burning rate. This property is a function of particle size and pressure and should be adjustable. Particularly desired is a burning rate that is insensitive to combustion pressure.

Too, missile lubricants see service in fuel pumps, valve stems, and controls, must meet the same severe service conditions as propellents. Characteristics of the "ideal" lubricant are detailed in the box, *"What the Ideal Lubricant Must Have."*

One of the most promising new prospects is a lubricant coating based on Teflon fluorinated resin. An outgrowth of the Navy's effort to find all-weather lubes for aviation ordnance, it is said to be serviceable from —75 to 500 F. Limitations: high cost (about $75/gal.) and difficulty of application.

Continued progress in this area seems to hinge mainly on an increased understanding of the functions of various additives and on development of new lubricants and improved nonmetallic bearings. And it is almost certain that most new lubricants will be based on mineral oils. At the same time, synthetic oils will be used increasingly where severe conditions of temperature and shear prevail. Eventually, rocket engineers believe, missiles will use synthetic materials for almost all applications.

Closely allied to the lubricant problem is the quest for sealant and gasket materials that have high elasticity and exceptional physical stability at temperatures ranging from -65 to 160 F. Rubber and other common organic elastomers such as polyvinyl chloride

What the Ideal Lubricant Must Have

1. Good lubricity under heavy shear and over a wide temperature range.
2. Thermal stability at boiling point.
3. Viscosity of 1 centistoke at 700 F, and less than 2,500 centistokes at O F.
4. Resistance to oxidation and deterioration by the highly corrosive missile fuels.
5. Hydrolytic stability.
6. Noncorrosiveness to standard materials of construction.
7. Incombustibility.
8. Ease of handling.
9. Low cost (at least, potentially).
10. No toxicity.

C W Report

and polyvinyl ethers swell, stretch or melt when subjected to the corrosive liquids and high temperatures and pressures regularly encountered in missile operations.

One of the more ingenious approaches to the sealant problem involves the use of a pressurized bag that obviates the need for a fuel pumping system (*CW, March 26, '55 p. 48*). By simplifying design, this gambit eliminates many gaskets and seals. It also sets up a potential market for any producer of flexible plastics that can come up with a nonporous, corrosion-resistant pressurizing bag.

An important lesson to be learned from this is that the opportunities for the chemical industry in this area, as in almost all areas of the guided missiles field, are limited only by the imagination of researchers.

Metals, Alloys and Cermets—The sound barrier is not much of a problem for today's slim, needle-nosed missiles. Missile designers now worry about the thermal barrier, shock waves and ionization.

About the time a missile hits the upper atmosphere (about 60 miles up) on its way back to earth, it is moving at almost 15,000 mph. Even the thin upper air in contact with the missile's surface creates enough friction to melt most known materials at this speed. At lower altitudes, the air becomes virtually a stone wall that wallops the missile with deceleration forces up to 20 g.

At this point, skin temperatures to 7,000 F and pressures of 1,000 psi. are common. Clad in a metallic skin only fractions of an inch thick, the missile is in danger of disintegrating while still miles away from its destination.

There are many possible answers to these problems. Two show particular promise, at least from the chemical industry's point of view. One is internal insulation that could be used where needed to protect certain vital components such as propellent tanks and warheads; it would, for example, keep liquid oxygen boil-off to a minimum. Insulation materials up to the job, however, are still unknown.

The other approach, probably more important, is concerned with development of improved thermal- and shock-resistant alloys for missile coverings. Such alloys would have to withstand the elevated temperatures and pressures encountered on atmospheric re-entry for only very short periods (up to 20 seconds).

In this respect, the most critical part of the missile is its nose, which must bear the brunt of the impact. Two materials used for nose skins are 0.019-in. stainless steel and 0.125-in. aluminum. Easily obtained and fabricated, these metals are perhaps the most satisfactory materials now available.

Aside from surface temperatures, missile men have to worry about the terrific internal heat generated by the motor. One estimate pegs the heat transfer rate at the exit throat of a rocket motor at 5-8 Btu./sq. in./second/degree F.

Heat transfer of this magnitude necessitates the use of ceramic materials and cermets (as nozzle inserts and liners) to protect the metallic coating of missile motors. Choice of a specific refractory material is a function of many factors—e.g., hardness, thermal stability and conductivity, oxidation resistance, fabrication tolerances permitted, and type of backing material used. It is almost impossible to predict which material will prove best for a given application.

Among refractory materials now in use are graphite, ceramic oxides, and certain silicon carbide compounds. But as missile engines improve, many of the present refractory coatings will undoubtedly fall short of the increasing demands placed on them.

Rocket nozzles of graphite, satisfactory for missiles with short firing times, are already giving way to nozzles made of better refractory materials (e.g., zirconium boride) in the newer missiles with longer firing times. And, to obtain higher engine performance, missile engineers are switching to new materials of construction such as molybdenum—it's clad or plated with nickel for oxidation resistance, takes a nickel molybdate binder to prevent bleeding of the nickel into the molybdenum.

The chemical industry is getting only a small share of the market for materials of construction. Missile manufacturers use steel and various ferroalloys to fill most of their application needs.

Right now, most of these ferrous metals are doing a good job. But the picture could change overnight. Already evident, for instance, is the need for materials of construction that are serviceable in the temperature range from 1,200 to 2,400 F.

Which industry will supply these materials? Steel, nonferrous metals, or, perhaps, the missiles industry itself. It's a big market, worth presently in the neighborhood of $250 million/year.

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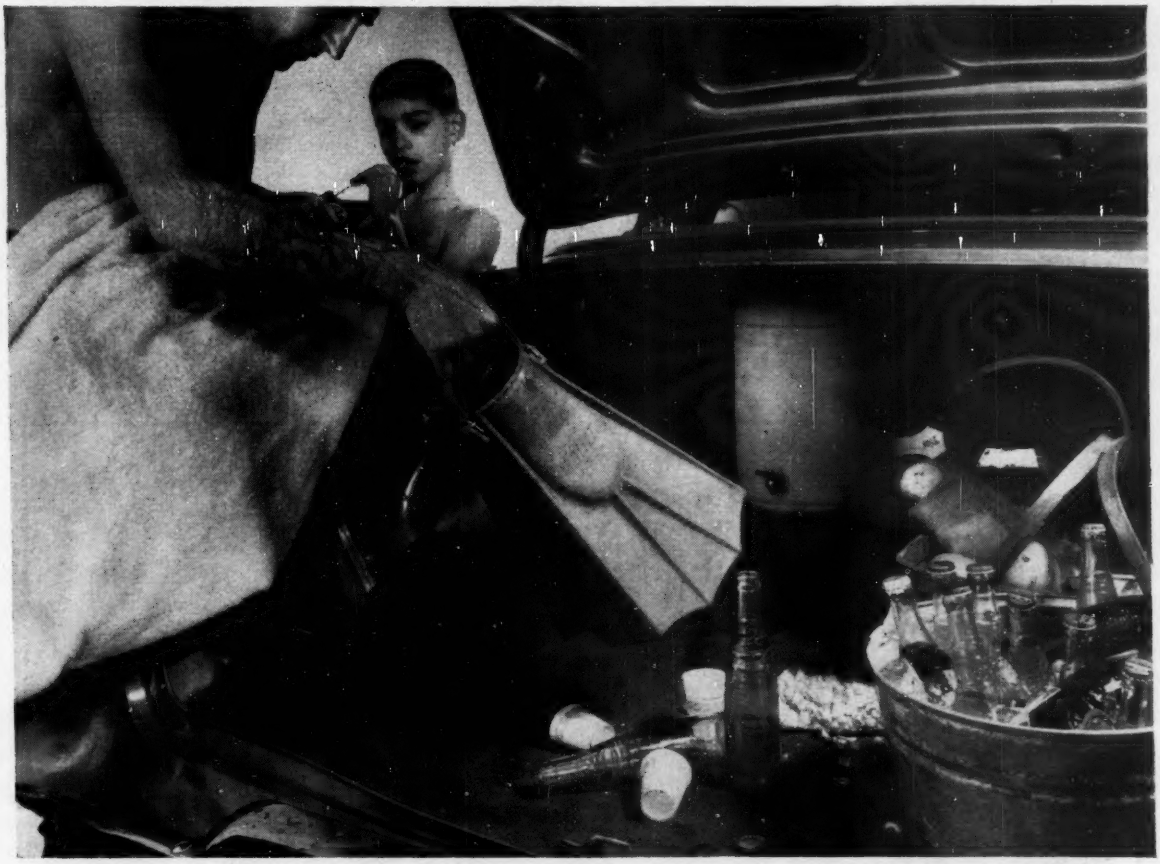

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Look Ahead—The hope of all missile men is a stalemate. Their goal is the ICBM, a 5,000-mile intercontinental ballistic missile that will speed its thermonuclear warhead through outer space at 16,000 mph. to hit within 10 miles of a designated target. The theory is that when (it's no longer a question of "if") both sides develop such a weapon, neither will risk starting a war, for fear of total annihilation.

The validity of this reasoning is for political philosophers to debate. Meanwhile, the major powers are racing ahead with development of intercontinental ballistic missiles.

This is what it presages for the U.S. chemical industry:

- The missiles industry, grown from almost nothing to a \$5-billion investment in a decade, will develop at an even faster clip from here on. Military spending on missiles will pass the \$1-billion milestone this year, hit a record \$1.5 billion next year, and possibly \$2 billion in fiscal 1958.
- The chemical industry, currently getting about \$220 million for its part in the missiles program, could double its take from this field within the next five years—if it goes after missiles markets with the same enthusiasm with which it tackles civilian markets.
- Applications of missiles devel-

EASTERN PUBLISHERS SERVICE WIDE WORLD

Chemical Market in Missile Men's Armor

PROTECTIVE CLOTHING such as that worn by the propellent handlers (*above*) is still another outlet for chemical products in the missiles field.

These particular suits were developed by the Navy's clothing supply office (Brooklyn) as part of the joint service effort to evolve special protective clothing for those who handle the highly corrosive fuels and oxidizers (e.g., fuming nitric acid) that make up missile propellents. The suits are fabricated of cotton and covered with a resin-modified butyl rubber coating. The special-purpose suit (*left*) is of one-piece design with attached foot coverings and detachable gloves and a hose that brings in air for breathing and ventilation. Completely enclosing the wearer, the suit is designed for use in highly hazardous situations of short duration, such as loading and refueling or in battle damage action. The general-purpose suit (*center*), on the other hand, was developed for use in maintenance and operation of storage tanks, piping, valves and power plants. It consists of a waist-length jacket, bib-overall-type trousers, hood, gloves, and knee boots. A quick escape feature is incorporated in both jacket and trousers. Ventilation is through protected openings in the suit. Wherever missiles and propellents are being developed or used, suits of a similar nature (*right*) are in general use. They're made both of synthetic fibers (e.g., acrylics) and of the older butyl-coated conventional fabrics. Price of the finished suit generally ranges from \$20 to \$50.

C W Report

opments are not limited to the military. Potential civilian uses: passenger-carrying missiles, mail-carrying missiles, satellite vehicles (already under development), take-off assists for heavily loaded planes, jet reactors, rock drills, etc. Moreover, superior, all-temperature lubricants recently developed in conjunction with the Navy's work on missiles are already being used to service civilian planes, maintain expensive industrial machinery.

These are but a few possibilities. Because of military security, much missiles work cannot even be hinted at. But limited as the view is, it does reveal unparalleled opportunity for enterprising companies that are willing to take advantage of it. Here, truly, even the sky is no limit.

Meet the Authors

ALAN MENDENHALL (right) is a big, friendly guy with the handshake of a hydraulic press. A Hoosier by birth and a chemist by education, he is presently assistant to the director of chemistry at Reaction Motors, Inc. He now considers himself first and foremost a "bird" man, has been working in the missiles field almost since he was graduated from Indiana University. Before joining RMI in 1954, he worked at Redstone Arsenal (liquid propellent rockets) and, before that, at Thiokol (solid propellent rockets).

AT RMI, WILLIAM MITCHELL is regarded as a storehouse of propellent information. A chemical engineer by training, he received both his B.Ch.E. and M.Ch.E. at New York University, worked at Redstone and Argonne National Laboratory. During World War II, he served with the Army Chemical Warfare Service.

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PROBLEM:

to make plastisols that form a hard film

ONE APPROACH:

new polymerizable plasticizer from Carbide and Carbon Chemicals Co.

Carbide's Mathewson has the job of finding out if this development means a . . .

Boost to the $38-million Plastisol Market?

Conventional vinyl plasticizers may soon be sharing top billing in plastisols with an unusual new product that acts as a plasticizer before heating, polymerizes to a hard resin thereafter. Called Monomer MG-1, it's Carbide and Carbon Chemical's (division of Union Carbide and Carbon) answer to the long-standing problem of how to fabricate hard, rigid products from the easily processed plastisols. If successful, the newcomer could help push the plastisol market far beyond its current $38-million level.*

This week, Carbide is gearing to produce hefty quantities of MG-1, expects it to appear soon in commercial plastic items.

Overseer of the new entry's career is Carbide's plasticizer product manager, John Mathewson, who foresees a multimillion-pounds/year market for his charge. Mathewson has no qualms about its $1/lb. price (vs. 30-60¢/lb. for plasticizers), points out in this respect that the product is not necessarily intended to supplant plasticizers; it may be used with them to yield a wide range of hardness in plastic end-products.

*CW's estimate of the value of plastisols formulated for all uses in 1955.

While Carbide declines to identify MG-1 chemically, it's probably one of the polyethylene glycol dimethacrylate esters described in U.S. Pat. 2,618,621 (which the firm expects to offer for licensing).

Right now, the material is headed for use in foams, flooring, tank linings, wire coatings, toys, and other applications where relatively hard vinyl plastics are required.

Later on, it's expected to figure in the hot processing of vinyls by calendering, extrusion and molding techniques—although Carbide isn't stressing such applications as yet.

So far, MG-1's only known competitor is MPL Monomer, a product of Polyco-Monomer Dept. (Leominster, Mass.) of Borden's Chemical Division. Described as a "tetra-ethylene glycol dimethacrylate," it has been offered for several years in sample quantities. Originally promoted as an

The Difference

Plastisols are vinyl resins dispersed in plasticizers (e.g., di-isooctyl phthalate), require large amounts of plasticizer to obtain proper fluidity for processing. Applied by any of a variety of coating methods, then fused by heat, plastisols form films that are soft because of residual plasticizer.

Organosols are vinyls suspended in both plasticizers and solvent (e.g., methyl ethyl ketone). Applied like plastisols, they result in harder coatings. However, an additional solvent removal step is required that presents fire and toxicity hazards.

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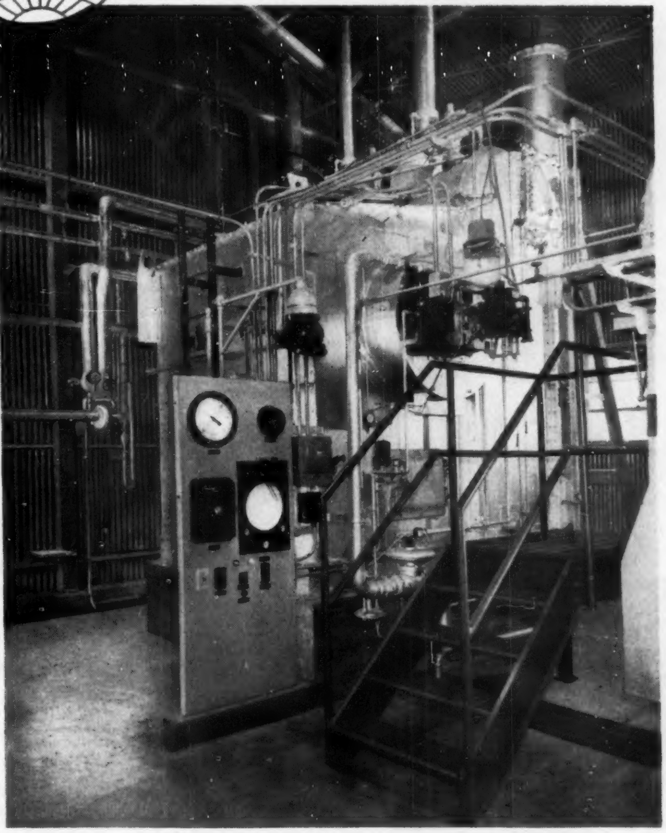

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acrylic cross-linking agent, it has recently been evaluated in plastisols.

Averring that MPL's future in plastisols looks very encouraging, Polyco plans to put MPL Monomer into commercial production, recently cut its price from $3 to $2/lb.

Among plastisol resin makers—including Goodrich and Bakelite—and formulators—including Stanley Chemical Co. (East Berlin, Conn.), Chemical Products Corp. (Providence, R.I.), Interchemical Corp. (New York), Elastomer Chemical Corp. (Newark, N.J.), and Rubber Corp. of America (Hicksville, N.Y.)—reaction to MG-1 is generally favorable. But the consensus is that, because plastisol formulating is so complex, a definite verdict on MG-1 will take more time.

All of these companies feel that since MG-1 is a monomer, it necessarily introduces a chemical reaction to the process not just a simple fusion step). This means more-critical processing conditions, more things to go wrong during curing. Also, MG-1 requires a peroxide catalyst that causes plastisol mixtures to gel in 1-7 days. This is not a problem if the formulation is used soon after mixing, but is a disadvantage in the plant where it's often impossible to prepare the exact amount required for the day's operation.

To these objections one fabricator says, "Sure, MG-1 is a little tougher to use, but this won't throw the experienced operator for a loss."

Entry of MG-1 into the plastisol field caps 7-8 years of research by Carbide. Many compounds of this type were evaluated, but it wasn't until last year that the firm felt it finally had turned up the right one. Laboratory to production scale-up followed recently.

As indicated by Carbide's lengthy efforts on this project, requirements for a polymerizable plasticizer are diverse and exacting. Some of the conditions it has to meet:

- It must be compatible with PVC resins and conventional plasticizers, both as a monomer and as a polymer.
- It must not solvate the resin at ordinary temperatures; otherwise, the plastisols gel, get too viscous. This excludes such closely MG-1-related materials as diethyleneglycoldiacrylate.
- It must cure rapidly in presence of usual peroxide catalysts at 300 F, but must not spontaneously polymerize at ordinary temperatures because the plastisol will gel. This excludes all common polyfunctional esters, e.g., diallyl maleate, diallyl succinate.

The product that Carbide has come up with reportedly fills this bill. It is described as a high-boiling, low-viscosity monomer that is not as volatile as styrene or even di-octyl phthalate.

To obtain cure and to speed the reaction, Carbide recommends that a peroxide catalyst (e.g., tertiary butyl perbenzoate or tertiary butyl hydroperoxide) be used (1-3% based on weight of MG-1). In some instances accelerators, e.g., cobalt naphthenate or octoates, can be used. This reputedly permits reaction temperatures as low as 250 F.

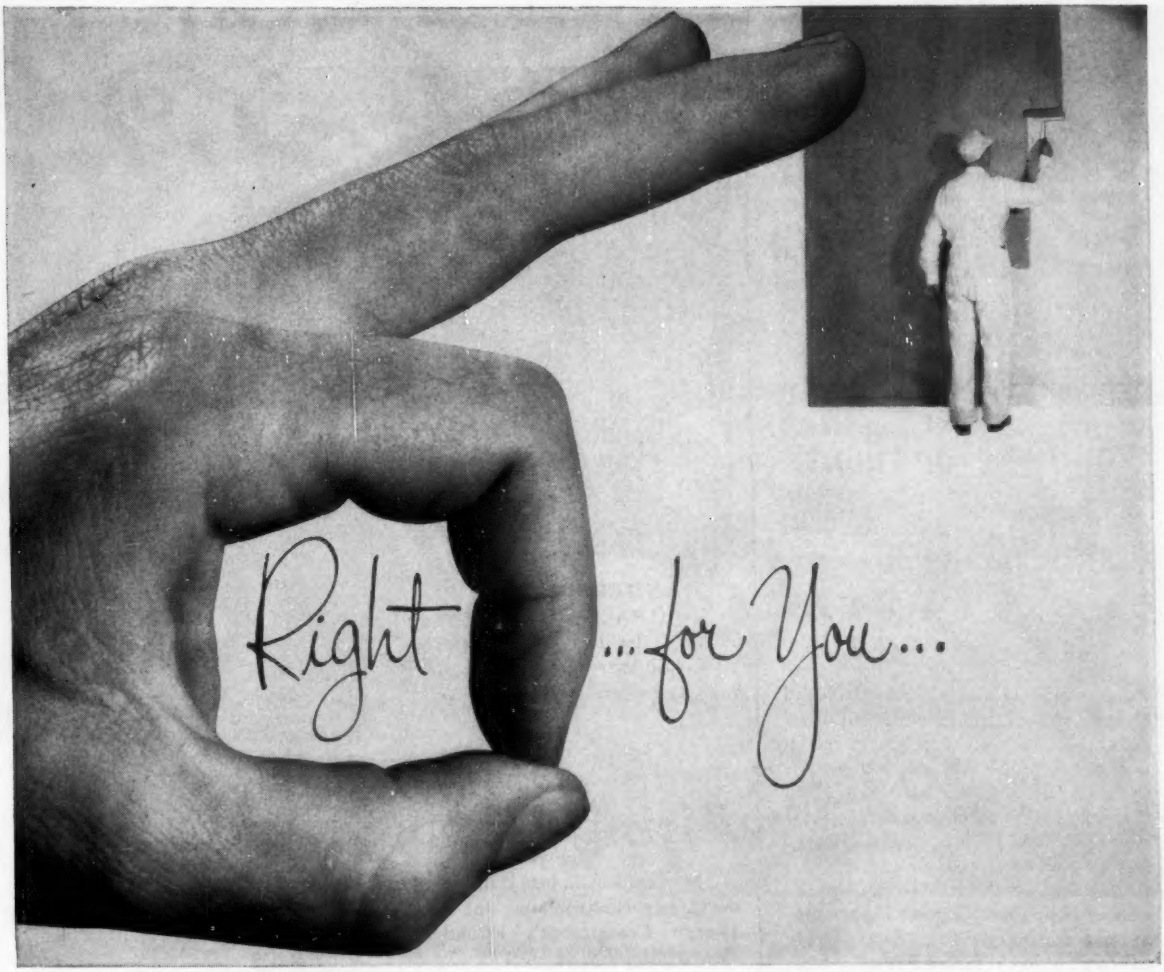
Carbide's new monomer contains 0.06% hydroquinone inhibitor, to protect it against polymerization during storage; but the inhibitor makes the use of a catalyst necessary. Carbide is looking for an inhibitor that does not pose this limitation.

While vinyl dispersions, both plastisols and organosols (*see box, p. 84*), are not new to the protective coatings field, their use has jumped sharply in recent years. Right now, the plastisols and organosols are not in competition with one another; each has its own specialized market. Biggest use for organosols is the area between conventional vinyl solution coatings and the heavier plastisols, e.g., appliance coatings, auto parts. And plastisols (although now in line for a good chunk of the consumer product business) at present are getting their heaviest play in industrial applications, especially where corrosion- or grease-resistance is required, e.g., fume ducts, plating tank linings.

Common Bond: Both types of coatings share advantages e.g., toughness, abrasion and corrosion-resistance—that give them an edge over competitive coatings in certain applications.

As the result of improved formulations, new low-cost application methods, new markets for plastisol products are opening up.

Carbide expects the new monomer to further this market upswing, declares that MG-1 may be only its first entry in a series of similar products that would possess a range of plasticizing action. But for now, Carbide has its work cut out in trying to make MG-1 a familiar item on plastisol formula sheets.



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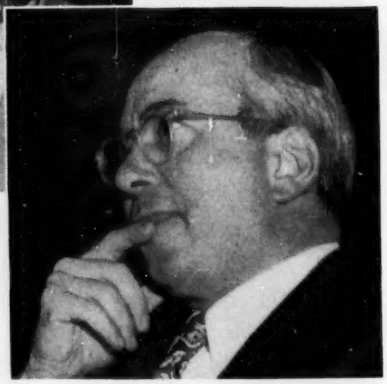


ANDERSON (above) AND STRAUSS: Key men in AEC declassification program, they clash over weapons reports, military propulsion reactors.

Airing Atom Secrets

The chemical industry this week is covetously contemplating the Atomic Energy Commission's recently reviewed backlog of 30,773 classified technical reports and memorabilia (CW Technology Newsletter, March 31). And for good reasons. Nearly half of the 10,916 completely declassified reports deal with chemical processing. What's more, there's a strong chemical flavor to many of the more than 14,000 other reports that will be made available only to firms and individuals cleared for AEC security.

The newly aired reports, AEC chemists say, deal for the most part with specific problems, in highly detailed fashion. Among them are a number that could prove useful to analytical chemists investigating chemical separation methods. Others deal with the recovery of uranium from sea water and ocean-floor sediments; several describe ion-exchange resin experiments; another records performance data of hot copper used to remove oxygen and nitrogen oxides from a gas stream.

But they concede that even the highly specialized reports—the ones that won't excite general interest in the chemical industry—could possibly contain just the answers needed to solve somebody's research problem.

An AEC official assesses the potential impact of the flood of reports this way: "Suppose, overnight, the plastics industry cleaned out its files of technical reports and intracompany memoranda and made it all public property the next morning. Collectively, chemical companies would find a lot of stuff that's old hat, probably a fair amount of junk. But by looking hard, individual and perhaps groups of firms would be bound to turn up a few things of real value."

But not everything the government's atomic scientists have committed to paper in the past decade will now be opened to public use. AEC is withholding 5,700 reports that deal with military propulsion reactors or weapons. And many industrial observers feel that this remaining nugget may be the most valuable information mine in all AEC papers. For this reason, the joint Congressional Atomic Energy Committee, headed by Sen. Clinton Anderson, has been pushing for their declassification—with the proviso that only scientific data and

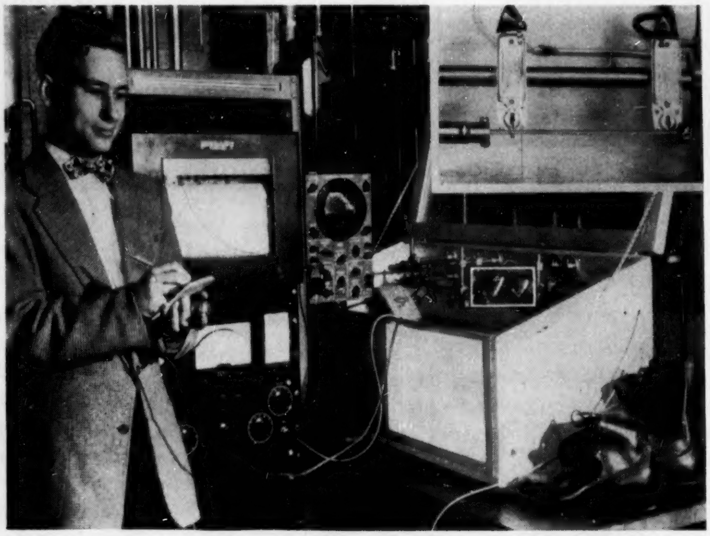
not actual military applications be disclosed. To this, AEC chief Lewis Strauss has still to reply. But Strauss does think that AEC's declassification efforts may not be fully appreciated.

Bearing out this view is AEC's latest so-called "crash" declassification program. In volume, the new entries to the declassified list exceeds the total released by AEC over the entire past decade. As time goes by, AEC (under Congressional prodding) intends to avoid piling up report backlogs, augment the declassified list.

From here on, new research and development by AEC's contractors and at the agency's far-flung installations will be screened for declassification as it is completed. AEC is also in the process of liberalizing its declassification guide—standards as applied by its screening team.

Meanwhile, even AEC is uncertain how much of the newly declassified material dredged from its files (by a reviewing team of 35 engineers and scientists at its Oak Ridge, Tenn., laboratories) will find ready application in manufacturing processes. For one thing, many of its reports of general industrial interest are included in the 9,000 published by AEC in years past. Sales of these reports, handled for AEC by the Commerce Dept.'s Office of Technical Services, have been mounting rapidly. OTS is currently booking orders for 10,800 copies a month, four times the volume sold two years ago.

Too, AEC's declassification officers are making a real effort to help industry find the information it may need, expediting reports the agency's scientists regard as of maximum po-



Testing with the Speed of Sound

DESIGNED for testing leather, this new ultrasonic device is equally applicable to natural and synthetic polymers, rubber, plastics, textiles and papers. National Bureau of Standards scientists Joseph Kanagy and Myron Robinson developed the equipment (under sponsorship of the Army's Office of the Quartermaster General). They find that sound velocity measurements vary with changes in leather fiber orientation caused by strain, aging or chemical treatments. Also observed: good correlation between sonic and tensile- and breaking-elongation tests. Nondestructive, the apparatus permits researchers to keep track of the egects of aging, chemical treatments, etc., on a single specimen.

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CHEMICAL PROGRESS WEEK — APRIL 23-28 — *A Better America Through Chemical Progress*

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tential value for civilian application. These, numbering some 500 considered both generally valuable and interesting, were the first screened for declassification. A second group of 2,000, judged to be of considerable potential value but of somewhat less general interest, were handled next. Those that passed muster after screening are among the 5,000 reports either declassified or down-graded from "secret" to "confidential" that have been made available since the "crash program" wound up last month.

Right now, declassified reports are being listed by title by AEC's technical information extension office at Oak Ridge, and published in semimonthly bulletins*. Concurrently, copies are being printed for sale by OTS, either as full-size printed reports (reserved for the most important documents) or as photostats or microcopies. Report announcement bulletins, listing titles by subject categories, can be ordered from Oak Ridge or from OTS. Unclassified reports (in summary form) will also find their way into AEC's semimonthly unclassified journal, *Nuclear Science Abstracts*. That comes at 25¢/copy ($6/year) from the Superintendent of Documents, Government Printing Office (Washington 25, D. C.).

DRUGS . . . . . .

Pain Palliative: A new surface anesthetic agent, 4-n-butoxy-β-(1-piperidyl) propiophenone, has been synthesized at S.M.S. Medical College (Rayasthan, India). Called Dyclonine, it's said to be highly effective, nonirritating, can be used in ophthalmic surgery.

•

Potent Steroids: Upjohn Co. (Kalamazoo, Mich.) researchers recently prepared a number of 11-oxygenated-steroid analogs that reportedly show higher androgenic potency than any hitherto reported. Most potent: 17-β-hydroxy - 9 - α - fluoro - 17 - methyl - 4-androstene-3,11-dione.

•

Better Vaccine: What is claimed to be the first effective tuberculosis vaccine that incorporates nonliving particles has been prepared by Guy Youmans of Northwestern University's bacteriology department. It's made by grinding TB bacteria, then centrifuging to separate the different-size par-

*A separate list of "confidential" report titles is available only to security-cleared firms.

RESEARCH . . . . . .

ticles inside the cells. The particles—though not alive—are still active as immunizing agents.

•

Soluble Sulfonamides: Water-soluble sulfonamides reportedly can be made with a solubilizing mixture of urea and hexamethylenetetramine. Solutions containing up to 30% of sulfa drugs are possible; they can be diluted with water to any desired proportion. It's all in recent Austrian Patent 180,656 to Osterreichische Stickstoffwerke A. G. (Austria).

•

Heart Slower: Acetylcholine has now been adapted by University of Chicago surgeons to slow down heart beat prior to heart operations. To speed up the heart, atropine is injected.

PRODUCTS . . . .

Reactive Hydrocarbon: Columbia Organic Chemicals Co. (Columbia, S. C.) offers pilot-plant quantities of allene (propadiene) as a highly reactive intermediate for polymer research. Price: $30/lb. in 1-lb. lots; $18.80/lb. in 100-lb. cylinders.

•

Bite Adder: B-Cap is the name of Evans Chemetics' (Waterloo, N. Y.) new synthetic pepper-like material that's used as the bite principle in a synthetic pepper being developed in this country. Chemically, β-cinnamylidene acetoyl piperidide, it has potential as an ingredient in prepared foods, toothpastes, mouth wash. Price: $43/lb. in 1-lb. lots; $25/lb. in 50-lb. lots.

•

Stem Saver: To inhibit stem end rot in citrus fruit, a recent Monsanto patent (U.S. Pat. 2,710,259) prescribes 0.5-10% of thionocarbamates in a water emulsion or isopropanol solution. The methyl, ethyl, isopropyl and propyl compounds are preferred; higher members of the series are said to injure the plant.

EXPANSION . . . .

Research building plans included the following items this week:

- National Gypsum Co. will double the size of its research center in Tonawanda, N.Y., at a cost of $1.5 million. If tests of new hardboard products are successful, the company also plans to build a new plant costing between $9-15 million. National Gyp-

RESEARCH. . . . .

sum only recently finished centralizing its research facilities in Tonawanda, previously maintained laboratories in several different cities.

• Davison Chemical Co. has broken ground for its new research ana development laboratory at a site midway between Washington, D.C., and Baltimore. A three-story, 52,000-sq.-ft. structure, it will be manned by 160 staffers.

• New York University plans a \$4-million engineering and science center at its University Heights campus (in the Bronx), has received a gift of \$2 million from financier Frank Jay Gould toward the center.

• Arthur D. Little, Inc. (Cambridge, Mass.) has completed arrangements for the acquisition of The Miner Laboratories, Chicago chemical consultants. John Kirkpatrick will manage the new ADL Midwest division (formerly Miner Laboratories). Carl Miner will continue to direct its technical operations.

REPORTS. . . . . .

These new Office of Technical Services reports mirror new government research, are available from OTS, U.S. Department of Commerce, Washington 25, D.C.:

• PB 111730 covers recommended methods of analysis for the determination of various elements in titanium and titanium alloys. Included are chemical methods for iron, chromium, molybdenum, vanadium, tin, aluminum, manganese, and nitrogen, and a method for spectrochemical analysis. Price: \$2.

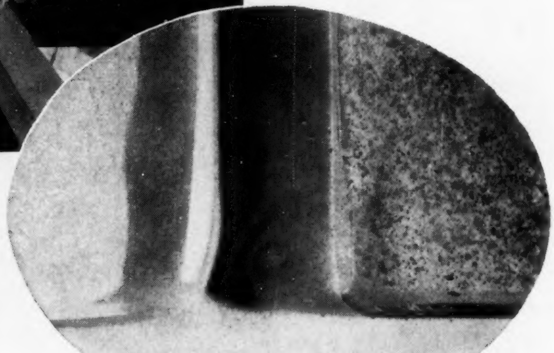
• PB 111788, "Tropical Performances of Fungicidal Coatings," discusses the abilities of six different fungicides to suppress fungus growth on varnish films. The list: pentachlorophenol, salicylanilide, phenyl-mercuric phthalate, uranyl nitrate, copper-8-quinolinate, *p*-toluene sulfonamide (best of all tested) and fifteen binary mixtures of these. Price: 50¢.

• PB 111727, "Foaming Characteristics of Recoil and Hydraulic Oils," includes studies of the effect of variables, such as water, grease, and temperature, on foaming tendency and stability. Seven oils are included in the research results, which show foaming increases if grease or water is present, decreases at elevated temperatures. Price: 50¢.

Life
on the Chemical Newsfront

CHEMICAL PROGRESS WEEK-APRIL 23-28

A BETTER AMERICA THROUGH CHEMICAL PROGRESS



MOLTEN METAL SPECKS BOUNCE OFF NEW PLASTIC, HT-CR-39 polymer *(left)*, made exceptionally heat and abrasion resistant by Cyanamid's triallyl cyanurate. The sparks leave the plastic surface unmarred *(inset, left)* but fuse to glass *(inset, right)*. Developed by Cast Optics Corp., Hackensack, N. J., HT-CR-39 rivals optical glass in clarity. It remains flat and rigid even at 230° F, where acrylics become fluid. By the Taber test, it is 35 to 45 times as abrasion resistant as the acrylics. Triallyl cyanurate, a new chemical combining three allyl groups with the exceptionally stable triazine nucleus, confers to a wide variety of resins a high heat distortion point, high temperature stability, stable electrical properties and high resistance to solvents, chemicals and fire. **(New Product Development Department, Section C)**

LOADING COSTS HAVE BEEN CUT as much as 50%, and unloading costs as much as 75% by the use of ACCOPAK® Paper Pallets over a year-long test period in Cyanamid and customer plants. In handling a flaked chemical in multiwall bags, loading cost was reduced from $27.80 per car to $17.77. The receiving plant reported that unloading costs fell from $22.86 to $4.06. Labor savings are dramatic: in another case, loading time was cut from 12 to 6.8 man-hours, unloading time from 8 to 1.2 man-hours. With this pallet, a kraft paper sling between two spiral-wound paper tubes, unitized loads can be tiered without use of space-wasting platforms. Crush-resistant tubes allow easy re-entry of lift truck bayonet forks without damage to adjacent bags. Today, ACCOPAK Pallets are available to plants handling bagged materials. **(Industrial Chemicals Division)**

For liquid detergent formulations

try the raw material with the world's best references

NEOLENE 400

Neolene 400 is an established high-quality hydrocarbon that has earned a key position, not only with the world's foremost processors, but also with smaller compounders everywhere. Sulfonates produced from Neolene 400 are particularly well suited for compounding in liquid formulations. Latest sulfonation method, using SO_3 with Neolene 400, contributes to quality and production efficiency in liquid formulations. This procedure does away with handling, storing and disposing of spent sulfuric acid.

In addition to Neolene 400, you can count on Conoco for:

WATER-SOLUBLE SULFONATES—produced from Neolene 400. Available as sulfonate slurry, sulfonic acid, or in spray-dried and drum-dried forms.

OIL-SOLUBLE SULFONATES—manufactured by sulfonation of synthetically produced hydrocarbon under closely controlled conditions.

CONOCO H-300, a secondary plasticizer for vinyls—outstanding light stability . . . improved low-temperature flexibility . . . viscosity depressant and stabilizer.

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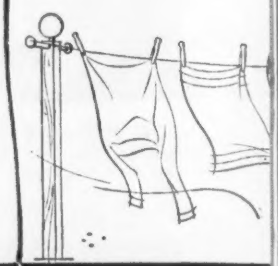
Petrochemical know-how from the ground up!

CHEMICAL PROGRESS WEEK-APRIL 23-28



CONTINENTAL OIL COMPANY

Technology

Newsletter

CHEMICAL WEEK
April 7, 1956

While the chemical opportunities in the rocket program are just shy of fantastic (*see CW Report, p. 61*), the challenge to technology is equally staggering. You can't talk about a lot of the things because of security restrictions. But, to get an idea of the sort of problem the industry is facing, you can put together information that's already been published.

Aviation Week predicts that Boeing Airplane will make its bid for a supersonic bomber with its Project 110—a chemically powered plane. It's not possible to say what chemical would be used, but you can bet that the slide rules are humming on calculations involving one of the new exotic fuels.

Take, for instance, pentaborane (C_5H_9). Wrote *Aviation Week*'s David Anderton, in the magazine's inventory issue: ". . . an impressive backlog of tests in rocket motors has confirmed [pentaborane's] high heat value, approximately twice that of conventional hydrocarbons."

Just how much pentaborane would be needed to fuel Boeing's Project 110 is a moot question. But aviation people say that the Russian plane that flew the diplomats to Britain consumed 9,600 gal. of fuel during its three-hour flight. Assuming that American technology is on a par with Russia's, that would translate to a consumption—of conventional fuel—in a B-52, say, of 6,000 gal./hour, or 40,000 lbs./hour.

Substitute pentaborane in a comparable project and you get a figure of 20,000 lbs./hour. Multiply that by 10 (hours in the air) and then by 100 (for a 100-plane armada) and you find a need for 20 million lbs. of chemicals for a single long-range bombing raid or maneuver.

Production on anything approaching that scale is out of the question right now, of course. H. I. Schlesinger, of the University of Chicago, has shown that pentaborane could be made by heating diborane at 250-300 C in the presence of mercury vapor catalyst. But yield from such a process is low.

Moreover, diborane itself is no cinch to make, economically. There are several ways it can be done. General Electric just received a patent (U.S. 2,737,447) on a process for making diborane (and lithium fluoride) from lithium hydride and boron trifluoride. GE's improvement: use of tetrahydrofurane as a solvent (instead of ether) to boost yields.

Another way of doing it is to react sodium borohydride with boron trifluoride to get sodium borofluoride and diborane. One objection to both these processes is that the metal hydrides themselves are pretty expensive starting materials (for a fuel, at least).

Schlesinger showed a reaction (*Journal of the ACS, vol. 53, p. 4321, 1931*) that on the surface, at least, looks to be worth probing. It involves making diborane from boron trihalide and hydrogen with an electric discharge.

In any case, an analysis of pentaborane's physical properties (in addition to its high heat content) shows why it's nailing down attention as a fuel. It's a liquid at temperatures above —47 C, boils at 65 C. It's not spontaneously flammable and—unlike most metal hydrides—doesn't hydrolyze readily.

Stability of the compound derives from its unique structure (elucidated by Linus Pauling, among others). It's a ring structure of four boron atoms. To one of the boron atoms on the ring is attached a BH_3 group; two hydrogen atoms are attached to each of the other three boron atoms.

Technology Newsletter

(Continued)

Present activities in tantalum presage new processes and a fuller life for the metal:

• Fansteel has a million-dollar expansion program under way and has already found its plans inadequate. So it will build a new, bigger plant well away from the Chicago area.

• Kawecki Chemical is all set to launch a major venture in tantalum.

• Horizons, Inc., is actively interested in the metal, has been measuring the market for some months.

• At least two other firms are known to have research programs going.

Fansteel has not decided what process will be employed in its new plant. But it's putting the finishing touches on a liquid-liquid extraction pilot plant and, if that proves out, the new unit will use the same process.

The present method for separating tantalum from columbium is the one developed by Marignac (in 1866), which depends on the difference in solubility in water of the double potassium salts of the two metals. The liquid-liquid extraction process was developed by the Bureau of Mines, is a hydrochloric extraction of mixed anhydrous pentachlorides in solutions of aliphatic ketones.

•

Tantalum processing is not cornering all the research interest at Fansteel, however. The firm is also shaking down a pilot plant for making silicon rectifiers; testing rectifiers made of a grade of titanium dioxide similar to that used in pigments; pilot-planting a new tantalum capacitor without liquid electrolyte.

•

Monsanto has just made its first shipment of tertiary butylamine from what it describes as the "first commercial-size unit built in the United States." The plant's located in Texas City; the first shipment went to the company's Nitro, W. Va., installation.

The firm doesn't say how it's making the product. But it does admit the Texas location was decided on because of the availability of raw materials: hydrogen cyanide and isobutylene. And the chemistry of such a reaction has been pretty well explored by New York University's John Ritter. He showed how a tertiary olefine reacts with hydrogen cyanide to produce the corresponding formamide, which hydrolyzes to the amine (*Journal of the ACS*, vol. 70, pp. 4045 and 4058, 1948). Example: he added di-isobutylene to acetic acid and sodium cyanide (then a drop of sulfuric) to form tertiary octylformamide. A tertiary alcohol can be used in place of the olefin.

This is a good bet not only as the basis for Monsanto's new operation, but also for Rohm & Haas' older production of the same type of compound. For several years, the latter has been making (and selling) a line of Primenes, which include tertiary butylamines as well as 8- and 12-carbon atom tertiary alkylamines.

Du Pont has also investigated the same area, went so far as to develop a direct, catalytic reaction of the olefin and ammonia to make the amine. Yields from this approach were disappointing, though.

•

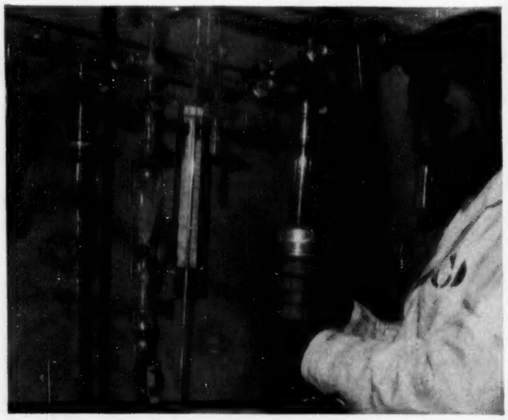
The process industries will get more help from the government in the battle against air pollution.

• The U.S. Public Health Service announced a $250,988 batch of grants, and negotiated 14 new research contracts on air pollution.

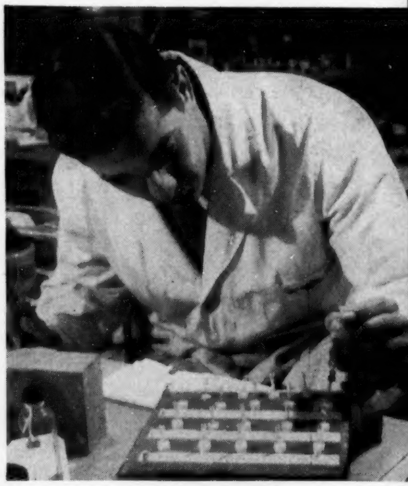
- In 10 years, industrial isotope users have multiplied from 18 to 1,250.
- Size of the average shipment has leaped from 30 to over 350 millicuries.
- At least 18 companies are now servicing this demand.

Here's how they're solving the tricky problems of commercial radioisotope processing in the chemical . . .

BIO-RAD'S SCHWARTZ reaps profits from atomic wastes.



MICROCHEMICAL PROCESSING of tagged compounds is typical of production on a laboratory scale.



BIG SELLER, by isotope standards, tritium is packed for shipment.

Industry's New Hot Spot

Though nuclear power has long monopolized the atomic energy spotlight, it's rapidly being eclipsed by its robust offspring—commercial radioisotopes. In just 10 years, these exceedingly abundant and widely useful by-products of nuclear reactors have risen from the status of a troublesome waste to pacesetter for the peaceful uses of the atom. And this year, for the first time, industrial applications of radioisotopes will outnumber medical and research uses.

Largely responsible for the spectacular rise of commercial isotopes is a relatively new branch of the chemical industry—the radiochemical processors. Starting with Tracerlab (Boston) in 1948, the field has grown apace, now includes more than a dozen companies specializing in the production of isotopes and "tagged" tracer compounds.

Though the commercial success of radioisotopes can be measured by the increase in industrial users (from 18 in 1946 to more than 1,250 today), it's impossible to peg the industry's dollar volume. Estimates are complicated by direct AEC sales to some users, by overlapping costs of equipment required for many industrial applications, and by the difficulty of subdividing the market—i.e., into industrial, medical, agricultural and basic research categories.

Consequently, producers' guesstimates of 1955 sales vary widely in scope, range all the way from $600,000 for industrial research and application and agricultural research to $5 million for all applications.

Similarly, the dynamic growth of the field and overlapping interests in nuclear instruments and accessories make it difficult to rate isotope producers by size. However, there are at least 18 companies—*see box, p. 108*—(excluding AEC and Atomic Energy of Canada) jockeying for position.

Growing Pains: Like any new chemical operation, commercial isotope production poses many unique processing problems. For one thing, synthesis of tagged compounds from radioisotopes must be conducted on a small scale, requires delicate microchemical techniques. And for another, radiochemical purity of the products is highly critical.

Too, the instability of radiochemicals makes it impossible to stock commercial quantities of many tagged compounds, especially those of short half-life isotopes. For, the very decay that makes them useful as tracers continuously depletes their strength. Even compounds containing long half-life isotopes may be rendered useless by too long a stay on the shelf. That's because radioactivity can cause decomposition of organics, polymerization of monomers.

Because of these difficulties, tagged-compound production is largely a custom business, better suited to small production and distribution facilities than to mass production techniques commonly employed by large chemical companies.

Typical of the young companies in this young industry is Bio-Rad Laboratories (Berkeley, Calif.), organized in 1952 by Tracerlab-alumnus Dave Schwartz. With both offices and production facilities housed in a single, unimposing Quonset hut, Bio-Rad did about $70,000 worth of business in basic isotope compounds in 1955, expects to do about $150,000 worth this year.

But isotopes haven't always paid their own way, says Schwartz. For despite its promising future, the tagged-compound market has been too small, too specialized, and too demanding to allow a company to flourish on isotope sales alone. Like other producers, who depend on instrument sales, consulting work, or other activities to help carry the load, Bio-Rad owes its survival to a sideline business.

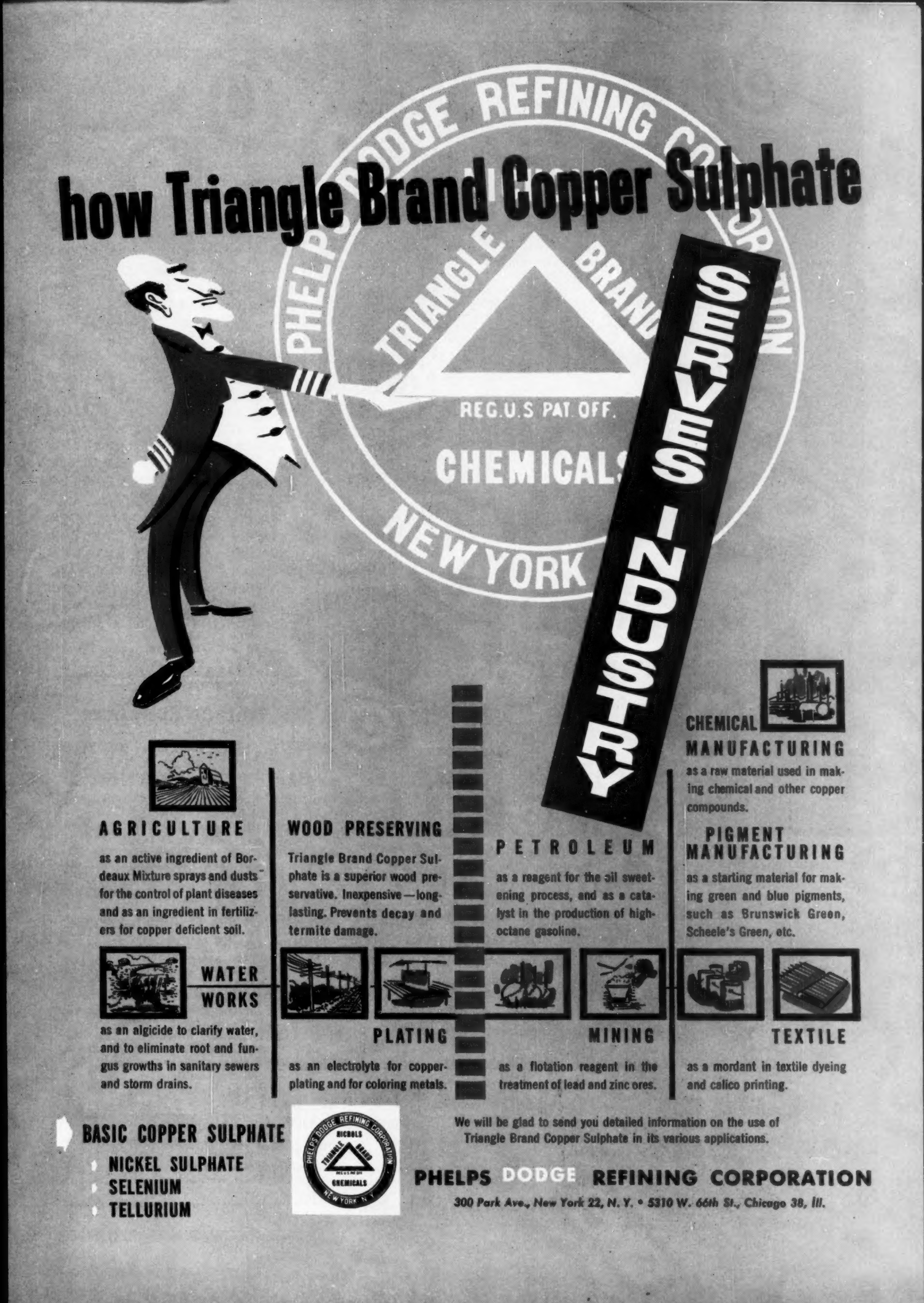
Shortly after Schwartz started producing tagged compounds, he found a need for extremely high-purity, accurate-size, analytical-grade ion-exchange resins. Since none were available, he entered into an agreement with Dow to process commercial exchange resins into grades required for isotope laboratory work.

Bio-Rad now sells over half of the total amount of resins used in research

How Radioisotopes Help

Industrial applications of commercial isotopes and tagged compounds utilize three basic principles of radioactivity:

- **Radiation affects material**—Isotopes ionize air in static eliminators, excite phosphorescent light sources, destroy bacteria in food and drugs, activate chemical reactions, polymerize monomers, and alter material strength and conductivity. Though currently the least exploited, this last-noted principle is expected to play a major role in future industrial operations, particularly in the chemical industry.
- **Materials affect radiation**—Applications of this effect include industrial radiography; thickness, density and liquid-level gaging; and analysis by radiation penetration.
- **Radiation traces materials**—Materials incorporating minute quantities of radioisotopes, can be located, traced or measured. Typical uses: tracing oil flow in pipe lines; control of catalyst flow rate; detection of leaks in buried pipe lines; measurement of wear and abrasion; studies of corrosion, diffusion, detergency, catalysis; and kinetics and mechanics of reactions.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as a reagent for the oil sweetening process, and as a catalyst in the production of high-octane gasoline.
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as a raw material used in making chemical and other copper compounds.
PIGMENT MANUFACTURING
as a starting material for making green and blue pigments, such as Brunswick Green, Scheele's Green, etc.
WATER WORKS
as an algicide to clarify water, and to eliminate root and fungus growths in sanitary sewers and storm drains.
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as an electrolyte for copper-plating and for coloring metals.
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in this country. And since radioactive contamination necessitates replacement of the material long before its adsorptive capacity is exhausted, repeat business is good.

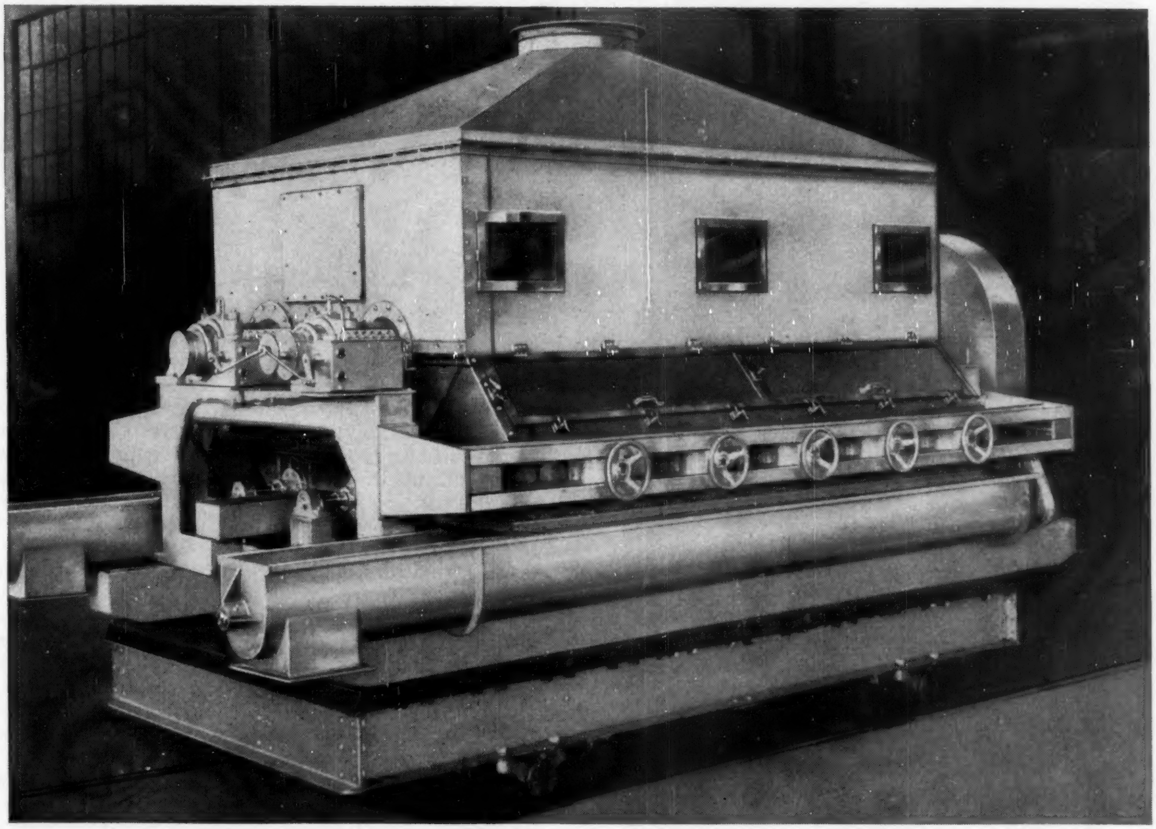
Common Problems: One of the major problems of the industry, says Schwartz, is that it can stock only about 25% of the items it lists, fills orders for only a handful on what might be called a large-volume basis. Bio-Rad, for example, lists 228 items in its new catalog, stocks only 50 (from which it fills about 40% of its orders).

Other processors, too, regard isotopes as pretty much a custom business. Isotope Specialties (Burbank, Calif.) produces over 100 tagged compounds, about the same number of industrial tracer combinations. But the most popular item last year brought in only $10,000 of the company's $150,000 gross.

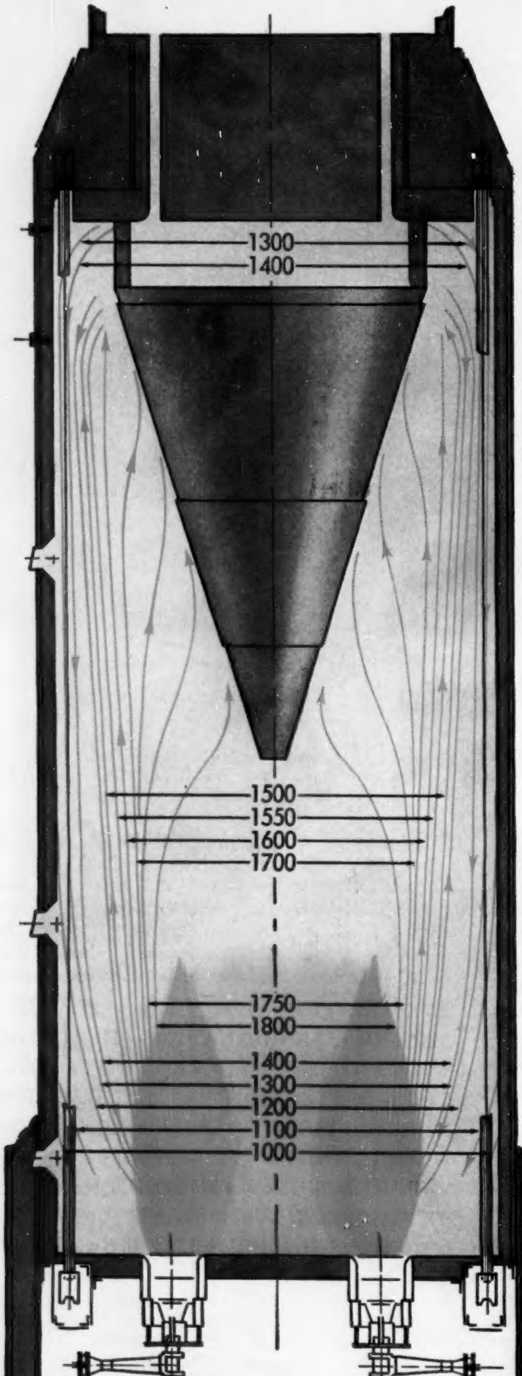
Another general problem that radioisotope producers must cope with is the AEC policy of giving an 80% discount to purchasers using the materials for their own medical and agricultural research. Some radioprocessors feel that this policy penalizes

Isotope Suppliers

1. **Abbott Laboratories** (Oak Ridge, Tenn.)
2. **Baker & Adamson Products** (New York)
3. **Bio-Rad Laboratories** (Berkeley, Calif.)
4. **Bjorksten Research Laboratories** (Madison, Wis.)
5. **California Foundation for Biochemical Research** (Los Angeles)
6. **Distillation Products Industries** (Rochester, N. Y.)
7. **Fischer Scientific** (Pittsburgh, Pa.)
8. **Charles E. Frost** (Montreal, Can.)
9. **Isotopes Specialties** (Burbank, Calif.)
10. **Merck** (Rahway, N. J.)
11. **Nuclear Instrument & Chemical Corp.** (Chicago)
12. **Orlando Research** (Orlando, Fla.)
13. **R-C Scientific Instrument** (Playa Del Rey, Calif.)
14. **Research Specialties** (Berkeley, Calif.)
15. **Schwartz Laboratories** (Mount Vernon, N. Y.)
16. **Technical Operations** (Arlington, Mass.)
17. **Tracerlab** (Boston)
18. **Volk Radiochemical** (Chicago)



PETROCHEM-ISOFLOW FURNACES



Here are the facts!

The first vertical cylindrical heaters provided even circumferential heat input, but vertical flux distribution varied considerably, from high transfer at the bottom of the tubes to low rates at the top. Improvements in design during the past twenty years have overcome this difficulty, by providing proper firebox proportions, a reradiating cone, and burners specifically designed to the requirements of the furnace.

It is significant that *only Petrochem-Isoflow furnaces* incorporate all three of these critical items of design.

The small, hot cone tip reradiates to the tubes, across a considerable distance. Because of the conical shape employed, each higher element of the cone is of larger area, and closer to the tubes than the section below. These factors compensate for decrease in cone temperature from tip to base, provide relatively constant radiant heat transfer over entire upper tube length.

The cone also serves to divert flue gases along the upper ends of tubes, which adds convection heat transfer over this length. It also initiates a high rate of firebox recirculation of combustion products, by cooling the gases in their passage across the tubes.

Being cooler, and therefore heavier than the rising gases in the center of the firebox, the gases adjacent to the tubes fall to the bottom of the heater by thermal siphon effect, increasing the heat input to the rear of the heating elements by convection. The descending gases also serve as a buffer between hot gases and the lower ends of the tubes and dilute the products of combustion. The special burners, by developing a symmetrical flame pattern, contribute to the equality of heat distribution over the entire radiant tube length.

Of the design features mentioned above, the cone is of the greatest significance because it is essential to even radiant heat distribution.

Experienced operators know that even heat distribution improves product quality, decreases tube deteriorations, results in longer, trouble-free operating cycles.

The Data Shown in the Drawings are ACTUAL PERFORMANCE RECORDS!

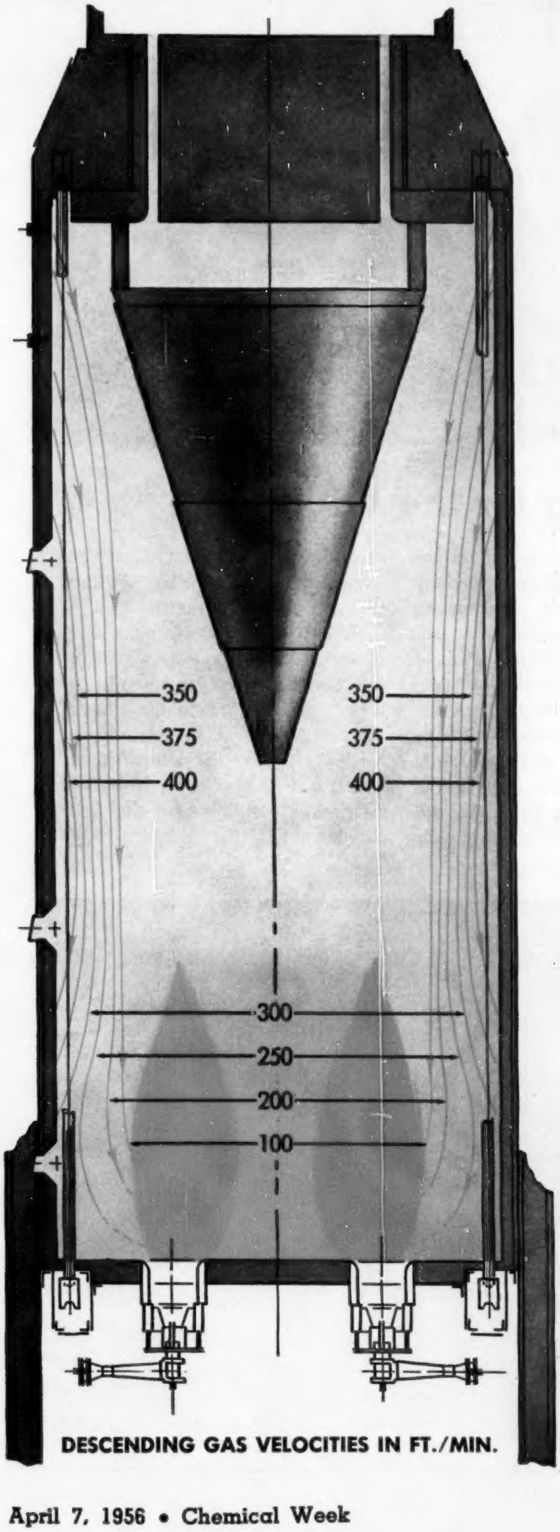
To check radiant flux distribution in Petro-Chem furnaces, exhaustive tests were made under actual operating conditions; some of the results of these tests are indicated in the two adjacent drawings.

Left: Plot of isotherms in a Petrochem-Isoflow firebox, illustrating the uniformity of firebox temperature.

Right: Plot of flue gas flow patterns and velocities, demonstrating the high gas recirculation rates.

Both of these phenomena are the result of proper firebox proportions, the two-fold action of the cone, and symmetrical flame pattern.

Provide EVEN HEAT Distribution !



In addition to even heat distribution, other all-important factors which determine the value and efficiency of processing furnaces include:

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PLENUM CHAMBERS FOR HAZARDOUS AREAS
SIMPLICITY OF DESIGN AND CONSTRUCTION
EXCESS DRAFT FOR HIGH OVERLOAD
EXPLOSION RESISTANT
MINIMUM GROUND SPACE
SHORT LENGTH OF LIQUID TRAVEL
ZERO AIR LEAKAGE
LOW PRESSURE DROP
LOW MAINTENANCE

In every case where these 11 all-important design characteristics were employed to compare one type of furnace design with another, PETROCHEM-ISOFLOW FURNACES were proved more economically desirable by any comparison.

More than 1350 Petrochem-Isoflow Furnaces have been installed since 1940—an unequalled record of acceptance based on proved performance.

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industrial users, who not only pay the full price, but also indirectly have to support medical and agricultural research. However, most agree that it hasn't been a very serious handicap. And from indications that AEC is getting out of the retail market, they expect it to be even less of a problem in the future.

Of more immediate concern is the somewhat erratic price structure of the basic isotopes and the possibility that AEC (which controls the entire supply) may change its regulations without any advance notice. The tremendous drop in the price of tritium is a good example.

A soft beta-particle emitter with long half-life, tritium is making a strong bid for wide industrial application in luminescent plastics and paints used for permanent, fluorescent-type lighting panels and markers. U.S. Radium is experimenting with this possibility; and Bio-Rad is supplying tritium for a research project currently being conducted by an Eastern paint manufacturer.

As recently as Aug. '55, tritium sold for $100/curie. Today, it's one of the cheapest isotopes, going for $2/curie.

Such drastic price fluctuations complicate long-range production planning, greatly increase the financial risk of carrying large inventories of tagged compounds.

If a company had big stocks of tritium on hand when the price was cut, says one processor, it would have taken a terrific loss—large enough to knock out all but the largest tagged-compound producers. And the same thing could happen if the AEC suddenly extended the 80% discount to commercial processors, though this is admittedly a highly unlikely possibility.

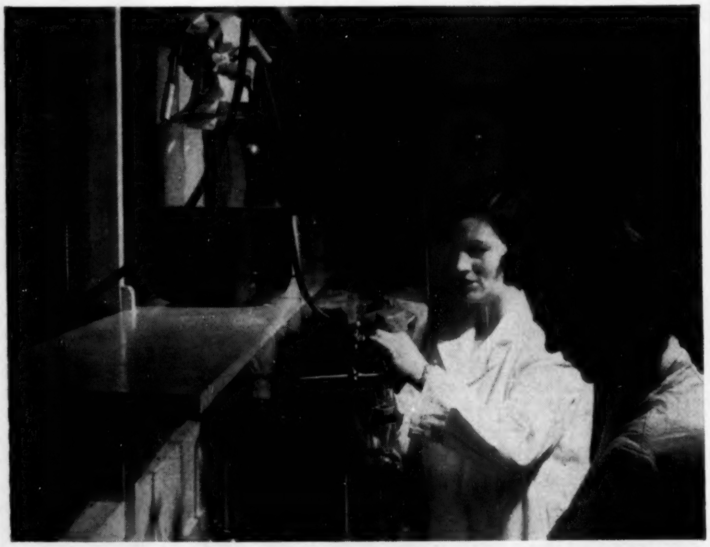
Bright Prospects: Judging by the rapid growth of industrial acceptance, production of commercial isotopes and tagged compounds appears to be in for a tremendous expansion. Radiography has already created a demand for thousands of curies of material. And large-scale chemical, food and pharmaceutical applications would consume millions of curies annually.

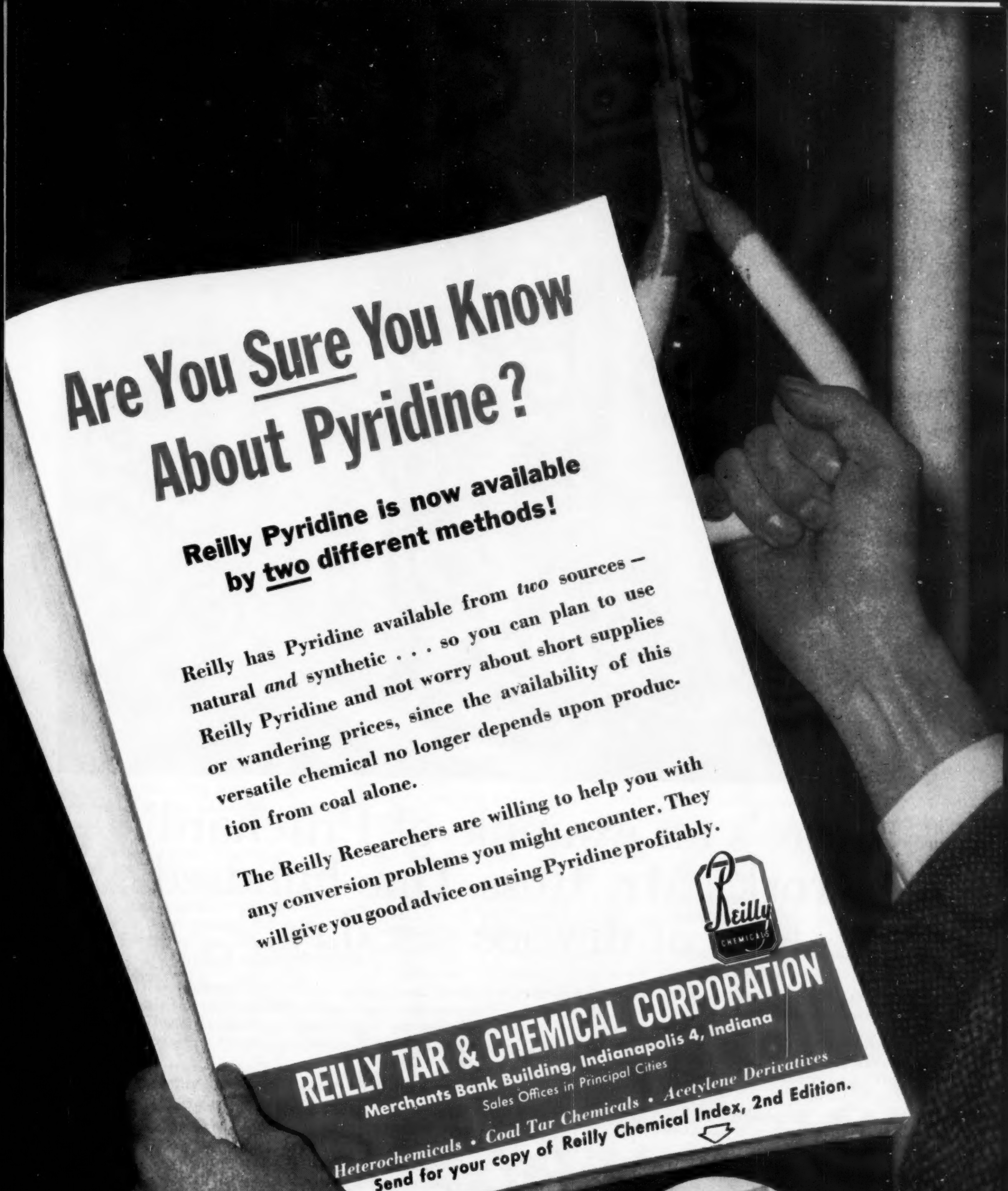
With plutonium production and the budding nuclear power industry guaranteeing a plentiful supply of raw materials, radioisotope processors should continue to reap profits from fission wastes.

Preparing for the Vaccine

STARTING the long, tedious process of making poliomyelitis vaccine, laboratory technicians (*above*) at the Connaught Medical Research labs at the University of Toronto fill culture bottles with Medium 199. The bottles are then sent to the culture room where monkey kidney tissue and virus inoculum are added. As a last step in the manufacture of the virus, the medium is drawn off by another technician (*below*). The harvested virus is sent to the U.S. where it's used to make the polio vaccine.

Although the Connaught Laboratories played a leading role in the Canadian vaccine program, it wasn't the only lab in the country to participate. The Institute of Microbiology at the University of Montreal was later given substantial assistance to supplement the Connaught output.





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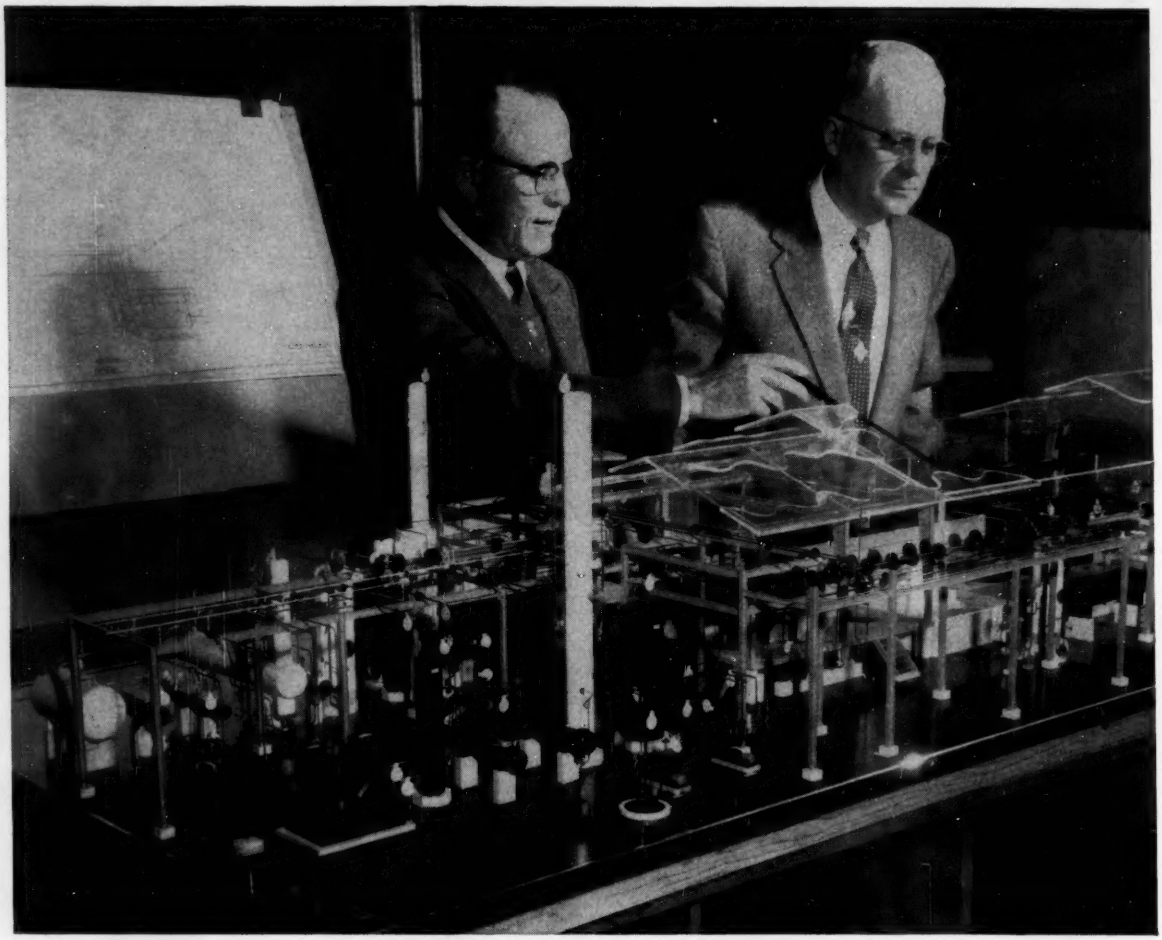

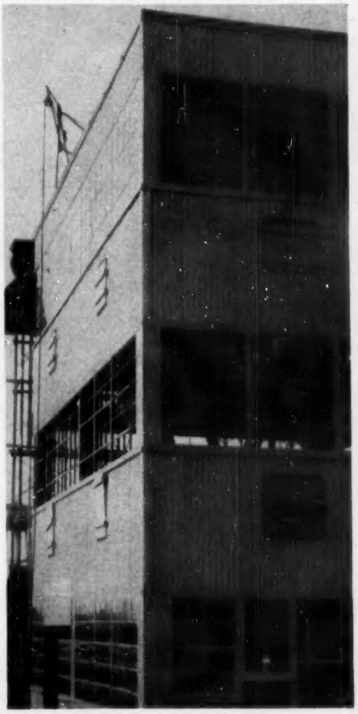

IS GOODRICH-GULF plant a . . .

Man-Built Tree?

The only similarity between the plant being built (*above*) and a natural-rubber tree is the product. But right there the resemblance is amazing:

It's Goodrich-Gulf's unit to make polyisoprene that's said to be the nearest thing yet to natural hevea rubber (*CW Technology Newsletter, Nov. 12*). What the plant will do is to direct the polymerization of isoprene to produce an oriented polymer. It has long been recognized that it would take a product of regular structure to approach hevea in properties.

In the case of polyisoprene, there are eight possible arrangements of the repeating units. Orientation can be accomplished during the propagation phase of the reaction, by holding the monomer in a definite position with regard to the growing chain, either by cybotactic forces (where the polymerization is initiated at the melting point of the monomer) or by adsorption of the monomer onto a solid surface (e.g., the surface of the catalyst itself).

Goodrich-Gulf uses catalyst systems derived from the work of Germany's Karl Ziegler. Goodyear is also exploring Ziegler-type catalysts in work along parallel lines. Firestone, however, manages to get a substantially similar product by using a dispersion of lithium in petroleum jelly as the catalyst.

A Metal on the Move

You can take it from Battelle Institute's C. T. Sims and Robert Jaffee: rhenium metal is bound to be produced in commercial quantities before very long.

The two Battelle workers took this stand at the Metals Conference of the American Institute of Mining and Metallurgical Engineers in Buffalo last fortnight.

Rare and Costly: Historically, rhenium has been a rare, expensive metal. Its selling price of approximately $1,000/lb. has been a big deterrent to market considerations. In this country, its scale of production is thought to be in the neighborhood of ½ ton/year.

But as Sims and Jaffee point out, there's actually an appreciable reserve of rhenium ores in the U.S. The difficulty is that the metal is usually found in trace quantities and in conjunction with other metals—usually copper and molybdenum. Getting it out in passably pure form is a many-stepped process. Here's how it's done:

The extraction process consists of oxidizing the rhenium sulfides to heptoxides, which are extracted with water (or caustic) to form the perrhenic acid (or sodium salt). These liquors are concentrated and the rhenium compound is converted into the insoluble potassium perrhenate.

The metal can be produced from the sodium salt by burning it in the presence of hydrogen. Because it's contaminated with alkali, the metal is then extracted and re-ignited (to avoid contamination with oxide). It's then compacted and sintered into a bar. Pressing and sintering operations are similar to those used to prepare tungsten and molybdenum.

But the techniques used in fabricating tungsten, for example, cannot be adapted to rhenium. As the Battelle team points out, rhenium can't be hot-worked in air because of inherent hot shortness. But at Battelle, it was discovered that cold working can be carried out if you work the surfaces of rhenium bars lightly to form a

layer of dense, strong metal that prevents initiation of edge cracking. Finally, reduction by cold swaging, flat or shape rolling can be conducted.

But because the metal work-hardens readily, annealing is necessary after each 1 or 2 percent of reduction for the first 10% reduction. After that, annealing is needed less often.

Rhenium's readiness to work-harden also causes difficulties in machining.

Going Places: Despite the obstacles and difficulties in producing metallic rhenium objects, however, work has continued on the metal, and progress has been made. Research in the U.S. got under way during the war, intensified after the outbreak in Korea. As a result, the Battelle workers point out, the metal's properties are much better known.

They see it gaining uses for itself as an electrical contact, in thermocouples and as filaments in electronics. Also, because of its wear-resistance, they can foresee its being used in pen points, phonograph needles and pivot bearings. It will, of course, never become a structural metal, but if the Battelle workers are right, it will be worth watching for special, small volume jobs where its special properties will outbalance its higher cost.

PROCESSES . . . .

Tetrahydrofurfuryl: Quaker Oats has started production of tetrahydrofurfuryl alcohol at Memphis, Tenn., by a new process. Developed by the firm's researchers, A. P. Dunlop, Horst Schegulla and F. J. Rice, it's a low-pressure catalytic hydrogenation, utilizing by-product hydrogen from a neighboring plant.

And thanks to the new process, the company has dropped the price of distilled tetrahydrofurfuryl 6½¢/lb. It's now 36½¢/lb. delivered east of Denver, and 37½¢/lb. delivered farther west. Saturation of the double bond is said to bring on a different set of properties (from furfuryl alcohol) and different applications. One of the newer uses for the material, it points out, is in synthesizing the amino acid, lysine.

•

Caustic-Chlorine: Hooker's new cells Type S 3-B will make their commercial debut in the firm's $11-million caustic-chlorine plant outside of Vancouver, Canada. They differ from the

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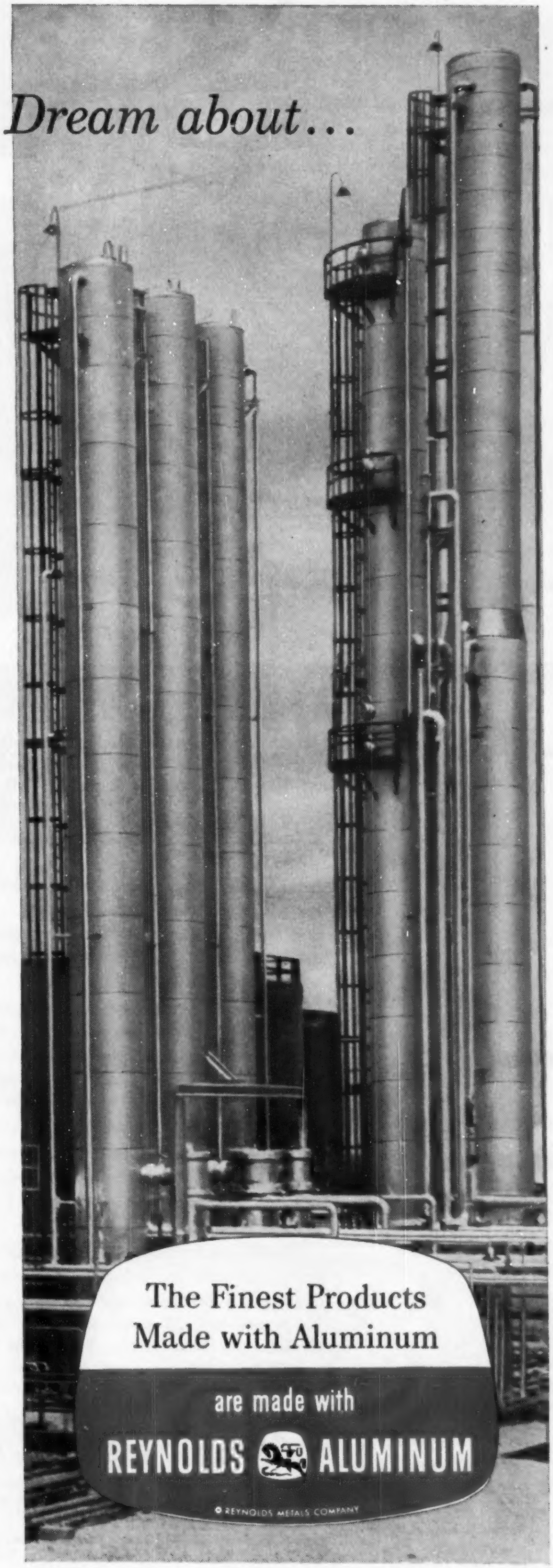

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older Type S 3-A in that they boost the operational ceiling from 27,000 to 30,000 amps., thus permit greater output with no increase in floor space.

•

Reserpine Licensing: From now on, Reserpine made and sold by S. B. Penick will be done under license from Messrs. Ciba, Ltd., Switzerland, in countries where Ciba has patents or applications. Further, says Penick, reciprocal license arrangements under patents issued as the result of Penick applications will be considered.

EQUIPMENT. . . .

Abrasives Pump: The Allen-Sherman-Hoff Co. (Wynnewood, Pa.) has developed a new line of Hydroseal centrifugal pumps for transporting abrasive materials, such as ash, slag, fly ash and coke. Two types are available: one is lined with rubber, neoprene, or other synthetic material for the pumping of fine solids; the other employs wearing parts made of hard metal alloys for handling sharp-edged solids. Both models come in a wide range of sizes, feature a clear water sealing system that's said to minimize frictional wear and eliminate inefficiencies of "double pumping."

•

Atmosphere Analyzer: For monitoring air pollutants, Harold Kruger Instruments (San Gabriel, Cal.) offers its new Series 70 analyzer that detects and continuously records low concentrations of oxidants, nitrogen dioxide, nitric oxide, and sulfur dioxide in the atmosphere or in other gases. Major advantages of the unit, claims Kruger, are its sensitivity, high speed of response, and versatility. One instrument measures up to 3 pollutants, records concentrations below 1 ppm.

•

Landlocked Marine Boiler: By utilizing space-saving features of marine boiler design, Cyclotherm Division—U.S. Radiator Corp. (Oswego, N.Y.) has developed a steam generator that, it says, takes up less than half the space required by the average package steam plant. The 150-hp. unit delivers 5,000 lbs. of steam per hour, features electronic control for maximum operating efficiency over a wide range of operating conditions. It comes completely assembled with factory-installed oil pump set to save space, minimize installation costs.

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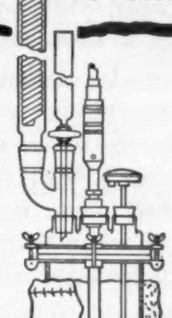

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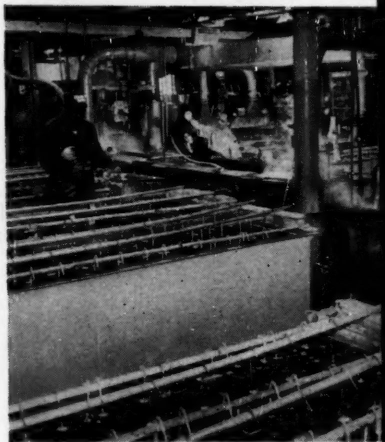

It may be a part of your next refrigerator that the workman is lifting out of the tank. Tanks shown are part of the equipment of Henry Nelkin, Inc., big New York electroplating firm. Millions of parts made of steel or iron are electroplated to protect them from rusting. Copper, nickel, cadmium, and other metals are used for the surface finish. Becco Hydrogen Peroxide is used to purify the plating solution. It is also used in a dipping bath to brighten articles which have been cadmium plated.

Known as "Vultures" in the trade, these feathers of the rhea or South American ostrich are being whirled on a drum and lightly beaten by overhead leather straps in a drying-room. Previously, they have been washed, degreased and bleached with Hydrogen Peroxide. Feathers from many parts of the world are used by the feather industry to make fans, dusters, Badminton birds, negligees, theatrical costumes and other commodities.

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Lithium requirements of these top outlets—chief factors in last year's doubling of lithium chemicals output summarize why . . .

Lithium Checks into the 'Big Time'

Interest in lithium and its compounds is running high. And there's good reason.

Last year, lithium chemicals shot into the realm of "big time" business, doubled 1954's production, set both marketers and technical men asking a lot of questions about lithium's future. Here, in preview, are some of the answers:

Last year, total U.S. output of lithium chemicals (in terms of lithium carbonate) zoomed to 12-14 million lbs., at least twice the '54 production level of 6 million lbs. In 1953, output was only 5.1 million lbs. but still way above the puny 10,000 lbs./year turnout of some 20 years ago when lithium chemicals were still specialty items.

And output is certain to climb considerably higher. Already, some observers foresee a production rate of over 30 million lbs./year by 1960; and a few years later, the industry should be making full use of its now-available 50-million-lbs./year capacity.*

Capacity Coverup: Industry and government officials adamantly refuse to estimate U.S. lithium chemicals capacity; so outside observers have to estimate on the basis of plant costs—not a wholly satisfactory procedure. Nonetheless, consensus of many observers is that present capacity is almost four times larger than the current production rate.

There are at least two reasons why the experts refuse to reveal capacity figures: (1) lithium is important to national defense; hence it is subject to stringent security regulations; (2) the young but fast-growing lithium business is obviously suffering from growing pains, and present producers aren't anxious to help others decide whether they, too, should climb on the bandwagon.

Anyway, would-be producers are apt to look twice at last year's production of 12-14 million lbs., compare it with existing U.S. lithium chemicals capacity of approximately 50 million lbs. As one observer put it, "If someone is thinking about getting into the business, or a present producer plans

*Several recently completed plants and expansions account for the present high U.S. lithium chemicals capacity: American Lithium Chemicals (subsidiary of American Potash & Chemical) completed a plant at San Antonio, Tex.; Foote Mineral increased capacity at Sunbright, Va.; Lithium Corp. of America put up a plant at Bessemer City, N.C.; Maywood Chemical Works has made moderate increases in its present facilities at Maywood, N.J.

further big expansions in the near future, I'd like to know what he intends doing with the product."

Aside from Defense: Tracking down the end-use pattern of the current output of lithium chemicals is difficult, too, because a part of total U.S. output goes into military applications—though trade followers generally agree that government needs do not exceed 20% of all lithium produced here.

However, 9.6 million lbs. (as Li_2CO_3) is a conservative estimate of industry's '55 demand for lithium chemicals.

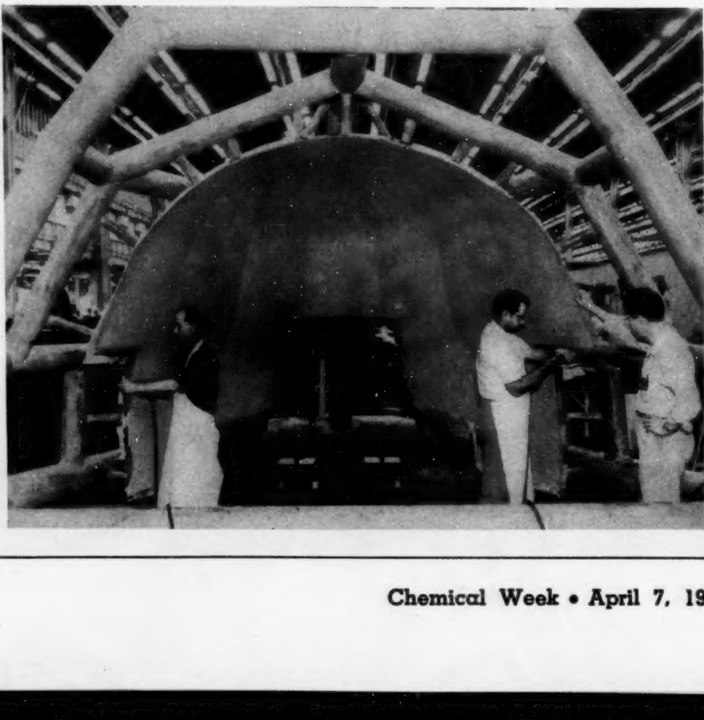
Of this, about 3.74 million lbs. went into lubricants; and an equal amount was consumed in the manufacture of glass and ceramics. Other uses—far smaller than these top outlets—were: brazing and welding, 672,000 lbs.; alkaline-type storage batteries, 528,-

Tooling with Epoxies

JIG-TIME ASSEMBLY of complicated objects is often possible through use of special plastic tools; example of plastic tool versatility is in the construction of the Hercules C-130, first U.S. turbo-prop to reach production.

About 10,000 of the nearly 50,000 parts (excluding nuts, bolts, rivets) used in the C-130 are made with plastic tools, dies, jigs and fixtures.

An attention-getter is the huge gauge (*below*)—with a shell made of epoxy resin-glass laminate — that's used to check alignment of the Hercules' whole upper-front window area.



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Specific Gravity @25/25°C.	0.963	0.9275	0.899	1.018	0.9855	0.952
Boiling Range 5-95% @760m.m.Hg °C	123-126	133-136	166-173	189-195	197-203	225-233
°F	254-258	271-277	330-343	372-383	387-397	437-450
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000; air conditioning and refrigeration, 480,000; organic syntheses, 336,000; miscellaneous, 96,000.

Lithium chemicals of particular importance in these applications are the bromide, carbonate, chloride, hydroxide, nitrate; but other lithium salts, e.g., aluminate, metaborate, cobaltite, manganite, silicate, titanate, zirconate, and zirconium silicate, are of interest —primarily in making porcelain enamels, ceramic glazes and refractory enamel fluxes.

It's in the manufacture of special-property greases and of ceramics that really outstanding growth has taken place. Together, these two major outlets accounted for 78% of all lithium chemicals used in this country last year. (In ceramics, lithium chemicals are utilized in the preparation of frits, ground and color coats; but not included here is the large use in ceramics of lithium ores in their original forms.)

The big puzzler is just how important lithium will be to the nation's nuclear energy program—and to this question there appears to be no ready answer.

For Tomorrow: At a glance, what may seem to be an enormous overcapacity for lithium chemicals is probably justified by the expected growth of established outlets, and mushrooming new applications—both industrial and military.

In fact, there seems to be no limit to the uses suggested for lithium chemicals, obviously, not all practical; some will be long in coming, but many others are now well on the way.

For example, ceramic coatings for metals—especially for paneling—are promising outlets for lithium compounds. And lithium chemicals are attracting considerable interest as reducing agents in various organic reactions; as catalysts in polymer technology; as alkylating agents in Grignard-type reactions (they're already used in making vitamin A); and as raw material in the production of metal hydrides and borohydrides.

Other growing or potentially important outlets include new fluxes for brazing and welding; oil additives; bleaches; propellents; de-icing materials; gas absorption; heat-treating salts.

With all these uses, it's easy to see why lithium is exciting interest throughout the chemical process industries.

SYNTHETIC SILICAS FOR SPECIALTIES

Tradenames	Manufacturers	Physical Characteristics	Range of Prices (approx.)
Protek-Sorb, etc.	Davison Chemical Co., Division of W. R. Grace & Co.	Amorphous gel, porous, with surface area in the range of 100-850 sq. meters/gram; produced in the liquid phase; a hydrogel.	20¢ to $1.20/lb.
Santocel (A, 54, C) Syloid (308, 162, AL-1, 244, 72, etc.)	Monsanto Chemical Co. Davison Chemical	Particle size, 3-5 microns: surface area, 150 sq. meters/gram; produced in liquid phase; untreated aerogel.	65¢ to $1/lb.
Hy-Sil (101, 202, 233, X303)	Columbia-Southern Chemical Corp.	Particle size, 0.013-0.025 microns; surface area, 100-215 sq. meters/gram; produced in liquid phase; untreated particulate.	9-11¢/lb. (most types; high-purity forms, 40-45¢/lb.)
Valron Estersil	Du Pont	Surface treated; particle size, 0.008-0.010 micron; surface area, 285-335 sq. meters/gram; nonsilicious solids, 6-11%; produced in liquid phase granular.	$1.50/lb.
Quso	Philadelphia Quartz	Liquid-phase production; particle size 0.015 microns; surface area 200 sq. meters/gram. Hydrophilic.	70¢/lb.
Syton (C-30, DS; new, 200) Mertone WB-4 Ludox	Monsanto Du Pont	Aqueous dispersions, 30% solids; Syton C-30, DS, and Mertone WB-4, particle size, 0.150 microns; Ludox, Syton 200, particle size 0.015 microns.	16-20¢/lb. of sol
Cabosil	Godfrey L. Cabot (plant in planning stage) Degussa (Germany)	Vapor-phase production; particle size, 0.015-0.020 microns; surface area, 175-200 sq. meters/gram.	68-85¢/lb.
DC Silica	Dow Corning Corp.	Vapor-phase production; particle size, 0.015-0.020 microns; manufacture in Degussa-designed plant.	81-87¢/lb.

Specialty Silicas: Plenty to Choose From

For versatility and wide range of applications, the synthetic silicas haven't many equals.

Characterized by fine particle size and extremely high surface area, they can do everything from boosting the strength of silicone rubber to putting a nonskid tread in high-gloss floor wax. Some new products that emphasize superfine size are now on the way:

- Monsanto is ready to provide pilot-lot quantities of a 10-15 millimicron aqueous dispersion (Syton 200).
- Philadelphia Quartz is distributing test quantities of a powder product of comparable particle size.
- Goodrich is also said to be trying a new silica, which is still only in research stage.

Despite the new products, and heavy research on new ideas, the silicas haven't yet hit the stride that all producers anticipated. In some cases, too, swinging production from the pilot-lot stage to full commercial pace has been tougher than expected. General Electric has had a silica plant planned for some time; there was talk it would be in production late last year, but it has not yet been put onstream. On the other hand, Godfrey L. Cabot (Boston), importing its material from Degussa in Germany, has found demand encouraging, may build a silica-producing plant in this country sooner than it had originally planned.

Individual Niches: The roster* shown above includes most of the currently offered silica types, shows some of the differences, some of the similarities. One thing it cannot illustrate is how, so far, the different silicas have developed their own individual markets. Though firms offer their products for a broad range of applications, each appears to concentrate on a few special outlets. That's one reason why the new Monsanto product excites interest—it's figured to be closely competitive to Du Pont's Ludox.

*Based on a chart prepared by Godfrey Cabot's Kenneth Loftman.

Typical Specialty Uses
Protective packaging; drying of liquids, gases.
High-temperature insulations; flatting agent for lacquers; reinforcing silicone rubber.
Rubber reinforcer; grinding aid; anticaking agent.
Nonsoap greases; silicone rubber reinforcement.
Thickener for greases, paints. Filler for resins.
Textile antislip agent; delustering agent; antislip agent for floor wax; antisoil treatment for carpets.
Reinforcement for silicone rubber; suspending agent; thickener; thixotropic agent.
Wax antislip agent; paper surface treatment, reinforcer for silicone rubber.

The individuality of the products has made each firm pretty closemouthed about product sales and potential. No figures on production for any of the silicas are now available, but the picture of relative end-use demand is generally thought to be this:

The hydrogel silicas, for drying purposes, are likely top-volume products. (One rough, and perhaps dated, estimate puts the consumption of drying silicas at about 200 million lbs./year; another 300 million lbs. are used by the petroleum industry in catalyst applications.) Other top consumers, in order, are rubber fabricators (silicas used as reinforcing agents); grease and lubricant makers (thickeners), and textile manufacturers (spinning aids, antisoiling treatments).

A specialty application that's believed to have considerable potential is antisoiling treatments. These are water sols of about 3% silica, with a little surface-active agent to improve fabric hand. Formulations can be sprayed onto rugs, upholstery, even wallpaper, to reduce soiling. (In this application, as in several others, patents limit what materials may be used and how. For the specialty formulator, however, many of the details of licensing, royalty payments, etc., are covered in the purchase agreements for the different silicas.)

Acres per Pound: The microscopic size and large surface area of the silicas is important to their antisoiling activity. Very briefly, the fine silica particles fill dirt-catching irregularities in the fibers, provide a sort of colloidal jacket for the fibers that is so smooth that dirt won't cling, yet so thin that fiber color is hardly affected.

The antisoilers are made from 30% (solids weight) sols of ultrafine silica. Although these have been around for several years, they were not the first silicas; historically, the first commercially important ones were hydrogels made by Davison. Amorphous, hard, and possessing vast internal surface area (on pore and tunnel walls), these gained prominence as drying agents. They absorb moisture, but change little in appearance—a characteristic of most silicas as they adsorb liquids.

Other processes, resembling the hydrogel process in that the silicas are precipitated from liquids, yield fine particles (in other cases, colloidal sols are produced, and are used as such). Purity varies from process to process, as does moisture content and physical properties. The important feature, high surface area, remains.

In their finely divided state, the silicas, though similar to sand in composition, don't have the latter's apparent abrasive quality. They are smooth and soft to the touch, are generally like a white talc. They have almost paradoxical properties—some can be safely used in lubricating greases; others (in textile spinning aids) increase interfiber friction. In paints and lacquers, they produce a flatting effect, but in floor wax, they reduce the slipperiness without greatly impairing the gloss. For these varied jobs, different silicas—though they have superficial physical resemblance—are used.

The silicas aren't always used as additives. Monsanto finds its Santocel is a very effective thermal barrier (e.g., insulating oven walls).

Silica Soot: While U.S. firms were concentrating on liquid-phase production, German firms developed high-temperature (1100 C) vapor-phase reaction where the fine silicas are produced as a sort of "soot." These were created to replace carbon black in rubber reinforcement applications—they're still used for that, particularly in silicone rubber, where they have superior properties at high temperatures.

For a couple of years, Dow Corning has had a German-designed plant producing silicas for its silicones (it has sold little to others). Similarly produced compounds are sold here by Cabot, which imports them from Degussa in Germany.

Like the aerogels and hydrogels, these have vast surface area—but external surface area rather than internal (on pore walls). And these "white carbon blacks" are as versatile as the liquid-phase products: they serve as reinforcing agents in natural, synthetic and silicone rubber; suspending agents to keep paint pigments from settling; flatting agents in paints; pigment extenders; thixotropic agents for resins. They form gels with water, alcohol, benzene, and other liquids; keep dry products from caking (everything from DDT formulations to table salt).

Competition from Cousins: Silicas haven't sewed up the markets in all these areas. For a great many jobs, they have plenty of competition from natural minerals, and from special compounds like the silicates (e.g., those of Johns-Manville and Huber). And General Electric, for one, is still seeking the silica that can meet its special requirements.

Nevertheless, silica makers aren't discouraged, figure that the proverbial sands of time will reveal, rather than conceal, the values of their synthetic sands.

Shave Suit to Rise Again

Before June 6, Colgate-Palmolive will petition the U.S. Supreme Court for a review of the latest decision—favoring Carter Products—in the aerosol shave cream suit. If the company fails to get a hearing by the high court—or if the present decision is upheld—Colgate will find it difficult to hold onto its billowing aerosol shave cream profits. Colgate sold approximately $5 million worth of the spray shaving aids in 1954.

U.S. Circuit Court in Richmond, Va., decided on March 8 that Colgate—and codefendants Stalfort Co. and Read Drug & Chemical Co., Inc. (both of Baltimore)—are guilty (affirming a district court ruling) of patent infringement, misappropriation of the trade secrets of Carter (maker of Rise). Penalties:

- An injunction against further infringement.
- Colgate and Read must pay damages to Carter on sales both before and since issuance of Carter patents (possibly triple damages).
- Colgate must turn over to Carter all patents and applications on its improvements on the Rise formula.
- Colgate must pay "a considerable portion" of Carter's legal fees.

Man with a Secret: The matter was summarized this way by one participant: "The judge found that Colgate and Carter both reached the same result—with the same man."

Norman Fine is the man—an erstwhile Foster D. Snell chemist who helped develop an aerosol shave product from an idea brought to Snell in 1949 by Joseph G. Spitzer. Snell came up with a workable product that was sold to Carter, marketed as Rise. Colgate watched Rise boom ($400,000 sales in '51, $800,000 in '52, $1.8 million in '53, $2.6 million in '54) and longed to duplicate it.

Although Colgate had 200 chemists, the decision states, "it was unable to develop a satisfactory product until it employed Fine, who had been working for Snell in the development of Rise." (Fine had left Snell voluntarily, had twice before unsuccessfully sought employment at Colgate.)

"Within a month of his employment," the decision continues, Colgate "put him to work on the problem, which he solved immediately by using the Rise formula in combination with a formula Colgate had found unsuccessful."

The winning formula was a combination of 80 parts triethanolamine stearate and 20 parts of triethanolamine cocoate, propelled with a Freon-114, Freon-12 mixture.

Colgate admitted infringement if the patent was valid, but contested the validity of the patent, stating that it wasn't really an invention. The court countered that Rise met all criteria—that it was new and useful, that Colgate chemists had tried unsuccessfully to reproduce it, and that it achieved unqualified commercial success.

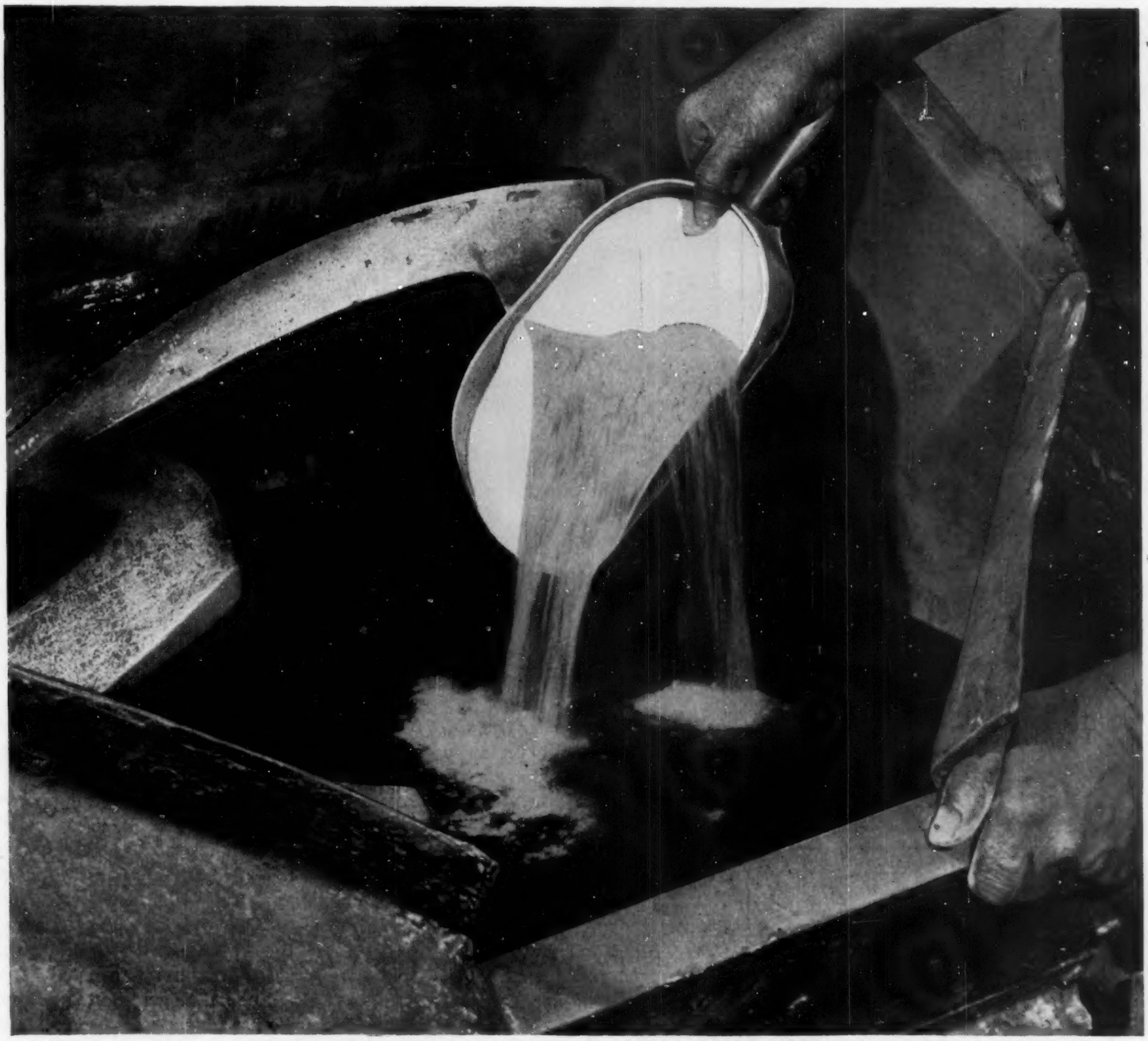
On the basis of earlier decisions, several firms—American Home Products Corp., Barbasol Co., Noxema Co. and Daggett & Ramsdell—have licensed the pressure shaves from Carter. Not a shave cream, but also licensed under the same patents is Procter & Gamble's Drene shampoo.

One safe bet: no matter what the legal outcome, Colgate will try to stay in the aerosol shaving cream business—the push-button shaves now constitute over half the entire shave cream market. If all appeal fails, Colgate will probably try to license, content itself with somewhat reduced profits.

Straighten or Curl: Key to a new product for either curling or straightening animal hair: nontoxic, noncaustic salt of thiolactic acid, plus a water-soluble gel-former (British Pat. 743,730).

Too Late for Flavonoids?

ONCE THE NOSE-BLOWING stage of a cold has set in, it might be too late for a bioflavonoid to do much good, suggests Gustav J. Martin, research director of the National Drug Co. (Philadelphia)—a maker of prescription hesperidin (bioflavonoid) drugs. Martin's reasoning: although they help to build up resistance to colds (i.e., building up capillaries of the mucous membranes), the usual ascorbic acid (vitamin C) and bioflavonoid combination will not cure one. The opinion was contained in a letter mailed to physicians. The citrus-peel-base drugs recently captured the public imagination when they appeared in several brands (*three are shown above*) of over-the-counter cold remedies (*CW, Nov. 18, '55*).



The above photo (courtesy of the New York plant of Sinclair & Valentine Co.) shows a molybdated toner being added to printing ink. This pigment is possible because . . .

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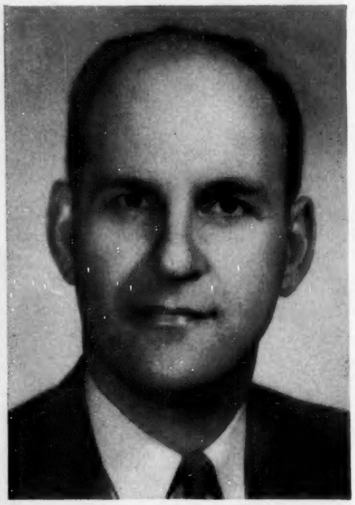

BOTTOMS, ABRAMS: Bonders of cellulose and copper, now . . .

Teamed Against Fungus

If National Cylinder Gas Co.'s (Chicago) claims stand up in practice, fungicide users will have a product—as yet untrademarked—that is both cheaper and better than their old wheel horse, copper naphthenate.

The new fungus fighter (which NCG will describe only as an "organic copper compound") is, says the company, 10-20% less costly to apply than copper naphthenate, while overcoming some of naphthenate's disadvantages.

Since the end of World War II, naphthenate has been the big industrial fungicide. It rode to that position because:

- It is superior in rotproofing to oleate, stearate, resinate, and tallate soaps of copper.
- It is resistant to leaching.
- It doesn't require the addition of a water repellent to prevent loss in weathering.
- It uses inexpensive solvents (kerosene, creosote, mineral spirits).

Water Carrier: NCG's new product is claimed to match these advantages (it uses, as a matter of fact, an even cheaper solvent: water), even adds some others. According to the company, the NCG treatment does not:

- Leave an odor.
- Impart stiffness.
- Cause stickiness.
- Affect dyeing, washing qualities of the fabric.

The product is said to modify the chemical nature of cellulose, without modifying appreciably the properties (except, of course, that of fungus resistance). A complex of permanently bound copper and cellulose results, so that prolonged washing with water or ammonia won't remove the copper (making fillers and binders unnecessary).

Buried Treasure: Invented by NCG's Robert Roger Bottoms, the fungicide has for six years been undergoing development and tests at Southern Research Institute (Birmingham, Ala.) under the direction of Edward Abrams, head of SRI's textile section. Sample results of partial tests (7 months of intended 12): breaking strength of treated fabric was 30% better than untreated, 20% better than copper-naphthenate-treated (under outdoor exposure tests).

In a soil burial test (strips of fabric buried in fertile soil maintained under ideal conditions of temperature and moisture for the growth of cellulose consuming organisms) it was found that while untreated cotton fabric disintegrated within 7 to 14 days, copper-naphthenate-treated cotton had lost 15% of its breaking strength in 14 weeks, and NCG-treated fabric had lost less than 10%.

Color Change: Treating of fabric will change its natural color to a tan

or a light brown (NCG suggests an ammonia rinse to bring it back to white, however). Dyes, as well as water repellents, flame retardants, resins, fillers or coatings, can be applied over the treatment, the company says.

Application of the fungicide, can be easily adapted to current procedures and equipment, says NCG, doesn't require expensive auxiliary machinery. Also important is the water solvent's lack of fire hazard.

Although the process is expected to prove of value to users of wood, paper, and other cellulosic products, first applications will be in textiles. Mildew-resistant cotton garments can be made from treated fabric, owing to the treatment's lack of harmful effects on human skin. It is neither a primary skin irritant nor a sensitizer, tests have shown. The fungicide will be made available to the textile industry within the next few months.

√ Product Plumage

Those flaming colors seen in fluorescent paints will be turning up on specialties packages within a few months — the first commercial letterpress inks using the extra-bright pigments are being offered by Switzer Bros. (Cleveland).

Long restricted to thick inks and paints that could be applied only by silk screening, spraying or brushing, the pigments have been adapted to high-speed press work by reduction of pigment particle size from about 5 micron diameter to less than 1 micron diameter. Still expensive ($3.35-5.70 in 100-lb. lots), and somewhat tricky to use (the press must be absolutely clean), the inks offer the same effective life (10-15 days) as do the original poster inks.

Right now, Switzer suggests varnish-coated labels to prevent ruboff, but hopes to eliminate this step soon. Offset printing ink is another project near completion; currently, only the letterpress ink (in six colors) is available. Offset ink poser: finding waterproof carrier.

Market

Newsletter

CHEMICAL WEEK
April 7, 1956

This week's top news for chemical marketers is the announcement, by the Office of Defense Mobilization, that the U. S. has completed stockpiling about half of the 74 critical and strategic materials needed by the nation. Of the total $11.2 billion of purchases contemplated by the government, $6.3 billion worth had been accumulated before the beginning of the year.

This means, of course, that a long list of materials—many of interest to the chemical industry—have automatically been dropped from the list of required materials. The quantities stocked cannot be reported, but here are the chemicals and related materials, now in adequate supply, that are of particular interest to chemical marketers:

In the "minimum stockpile" group—the more urgent of two main classifications—these are now in full supply: agar, aluminum, metal-grade Surinam-type bauxite, cadmium, castor oil, coconut oil, columbite, industrial diamonds, acid-grade fluorspar, graphite, Madagascar crystalline fines, hyoscine (known as the "pocket stockpile" because of the small amount needed), lead, battery-grade and metallurgical-grade manganese ores, and mica.

Other items in this category are: palm oil, pyrethrum, quartz crystals, quinidine, natural rubber, sperm oil, tin, tungsten, chestnut vegetable tannin, quebracho vegetable tannin, wattle vegetable tannin, and zinc..

In the "long term" group—a classification designed to provide increased materials security for metals and minerals—these items are now labeled "stocks full" (minimum needs for these items are also met): abrasives, crude aluminum oxide, chrysotile and crocidolite asbestos, Madagascar crystalline flake and other graphites, rare earths, tantalite and vanadium.

•

One stockpile item, pyrethrum, is in reverse gear. As recently reported (*CW Market Newsletter, March 24*), this item is overstocked and sale of the surplus will begin next September.

However, a belated notice by the General Services Administration now reveals that some 4,000 lbs. of the material have already been sold. This does not mean that GSA jumped the gun on sales; the pyrethrum was sold last fall—after a required six-months waiting period pursuant to an ODM declaration last spring that pyrethrum was overstocked.

•

A price reduction for pure itaconic acid and commercial availability of a technical grade are announced by Pfizer. Effective April 2, prices for the pure and technical grades are, respectively, 54¢ and 44¢/lb., in carload lots.

Simultaneously, the firm offers two new itaconic esters—diallyl and monoallyl itaconates—but only in research quantities; introduction of these materials brings to four the number of itaconic esters made available by Pfizer; the dimethyl and dibutyl itaconates were offered last spring (*CW Market Newsletter, May 14, '55*).

•

Of particular interest to plastics molders is a black phenolic molding compound now available in commercial quantities from General Electric.

Claims made (designated G-E 12906) include high impact properties, suitability for automatic molding processes, good granulation, fast curing. Recommended uses: switch parts, sockets, and various electrical control parts.

Market

Newsletter

(Continued)

The biggest chemical inventory on record—$3.2 billion—was on hand at the end of '55; but, cautions the Business & Defense Services Administration, stocks are still low in relation to sales because producers put a lid on inventory accumulation in anticipation of reduced sales.

However, after a look at the January figures—just in—BDSA predicts, for the next few months at least, a high and stable production volume tied closely to "variations in general business and industrial activity."

And a resumption of last year's steady rise in gross national product is anticipated by Commerce Dept. economists. Temporarily slowed in the first quarter of this year, a $402-billion annual gross product rate is expected in the current quarter. Chances are, too, that this level will hold through the third quarter, pick up to $410 billion in the last quarter of '56. The forecast, say the Commerce economists, is predicated on an expected increase in consumer buying power because of continuing advances in wages.

•

Sodium chlorate production in '55 jumped almost 25% to nearly 50,000 tons, while consumption (on a 100% sodium chlorate equivalent) was up 12%. In '55 again, herbicides continued as the chemical's top outlet; and in order of importance, the next three uses were pulp and paper bleaching, explosives, pyrotechnics and propellents.

•

With one month remaining in the crop year, gum naval stores output so far this season—144,660 bbls. of turpentine, 439,660 drums of rosin—is running about 14% behind last year's production.

Meanwhile, consumer stocks are declining; the reason: buyers are picking up just enough supplies to get by, hope to get bargain prices just before the new producing season gets under way.

•

More silicones are moving to consumers as several units at Carbide and Carbon's new Long Reach, W. Va., plant go onstream; the firm's Silicone Division will market the products in the U.S., Canada, and abroad.

Further evidence of a booming silicone market (*CW, Feb. 25, p. 87*) comes from a Carbide spokesman who notes, "Carbide's silicone reactor capacity has already been increased beyond the original design, and plans are being drawn for additional equipment for compounding silicone rubbers."

•

There's no dearth of cellophane buyers these days. Says Du Pont: "Cellophane is being produced as fast as possible, and we still have trouble keeping up with orders." Incidentally, the production cutback at Du Pont's Buffalo, N.Y., plant (*CW Market Newsletter, March 24*) applies only to Cel-O-Seal banding—not to over-all cellophane production.

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Ethyl alcohol, 190 proof, tax free, dms, c.l., dlvd., gal.	0.03	0.58
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Ethylbenzene, 99%, dms., c.l., frt. equald.	0.035	0.17

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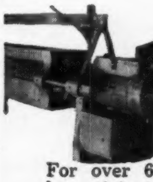

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(Advertisement)

CHEMICALS OUTLOOK

April, 1956

This news bulletin about Wyandotte Chemicals services, products, and their applications, is published to help keep you posted. Perhaps you will want to route these and subsequent facts to interested members of your organization. Additional information and trial quantities of Wyandotte products are available upon request . . . may we serve you?

PLURONICS IMPROVE LEVELING OF DYES FOR WOOL, COTTON, AND SYNTHETICS

Wyandotte Pluronics -- a new series of 100%-active nonionic surface-active agents of unique chemical structure and high molecular weight -- offer the textile industry many advantages as scouring aids and as dyeing assistants in dye leveling.

Properties of the Pluronics, responsible for their commercial acceptance as dye assistants, include: stability to acids and alkalies over the entire pH range; compatibility with metal ions; excellent dispersing of dyes, pigments, lime soaps, and soils; good penetration; extremely low to moderate foaming properties; and their availability in liquid, paste, or <u>flake</u> forms, all 100% active. The dispersing properties of the Pluronics, combined with their stability throughout the entire pH range, makes them particularly useful in acid baths.

<u>In the dyeing of wool</u>, it has been found that Pluronic F68 effectively disperses, suspends, and aids the penetration of both acid and chrome dyes -- helping to produce colors that are brilliant, clear, and level. It is also an effective solubilizing agent for many dyes which are normally difficult to put into solution.

Improved leveling of both direct and vat dyes can be achieved with Pluronic F68 in the <u>dyeing of cotton</u>. F68 is also useful as a dispersing agent for diazo salts which form diazonium dyes directly on the fabric . . . and as a dye assistant for <u>synthetic and synthetic-wool mixtures</u>, <u>spun nylon</u>, and <u>acetate rayon</u>.

F68 is the Pluronic* grade which has been most generally used in these applications. It has no cloud point.

Pluronic L61 has virtually <u>no foam</u> in most systems. The L61 grade has been successfully employed as a foam suppressant, vastly reducing the foam of soaps and other nonionic detergents and wetting agents. <u>A data sheet on the use of Pluronics in dye leveling is available.</u>

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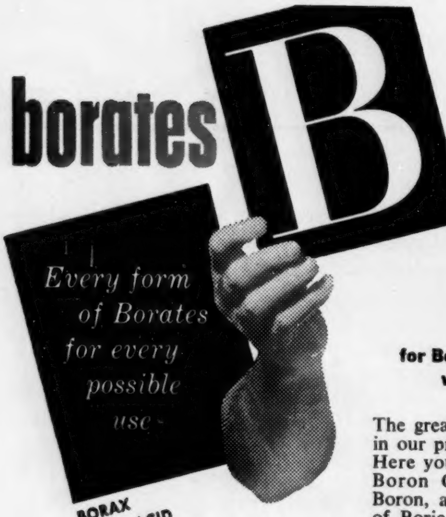

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